Testimony of John Lampe

Chief Executive Officer

Bridgestone/Firestone, Inc.

Before the Subcommittee on
Commerce, Trade and Consumer Protection

and the Subcommittee on
Oversight and Investigations

House Committee on Energy and Commerce

Hearing on the Ford Motor Company's recall
of certain Firestone tires

June 19, 2001

I. <u>Introduction</u>

Chairman Stearns, Chairman Greenwood, Chairman Tauzin, and distinguished Committee Members, I am John Lampe, CEO and President of Bridgestone/Firestone, Inc. Thank you for inviting me to testify today. Since I appeared before this Committee on September 21, 2000, much has happened. Our team at Bridgestone/Firestone has been working vigorously to protect the safety and restore the trust of our customers by assuring and enhancing the quality and performance of our products. We have accomplished a great deal, and we have learned a great deal.

In my statement today, I would like to address the following four topics:

<u>First, Firestone takes responsibility for the safety of its customers</u>. We have devoted all available resources and energy to the August 9, 2000 recall. We conducted extensive research to determine the causes of tread separations and rollover crashes involving the Ford Explorer. We instituted targeted changes to improve our products and we have enhanced our ability to monitor the performance of our tires in the field.

<u>Second, Firestone tires on the road today are safe</u>. The recall of more of our tires is not necessary and will not increase customer safety. I will present data that prove our tires on the road today are every bit as safe as the comparable competitors' tires on the road today.

<u>Third, to find the whole truth regarding Ford Explorer rollover crashes, it is imperative that Congress, NHTSA, and the public examine the vehicle issues as well as tire</u>

issues. I have said from the outset that no research, analysis or remedy for tire-related Explorer rollover crashes can be complete without carefully addressing the contribution of vehicle characteristics. Today, I will present claims data that show that the same tire on vehicles other than the Explorer performs quite well and that the tread separation rate, while still low, is elevated when that tire is on the Explorer. I will also present test data that precisely identifies that characteristic of the Explorer which makes it extraordinarily prone to rollover crashes in the event of a tread separation, an event that can happen with any tire.

Finally, I want to take this public opportunity to make Firestone's recommendations as to how drivers can help protect themselves against the possibility of serious crashes like those that prompted the Committee to investigate this matter.

II. The Recall

Beginning on August 9, 2000, Firestone voluntarily recalled approximately 6.5 million P235/75R15 ATX and Decatur Wilderness AT tires fitted primarily on the Ford Explorer family of vehicles. Our concern for the safety of our customers was paramount, so we took this action before we knew what caused the increased rate of tread separation claims. I am proud of the fact that our recall campaign was carried out very rapidly. From the date we announced the recall through January 2, 2001, we replaced 92 percent of the tires. As of today, more than 6.3 million tires have been replaced, approximately 97 percent of the total number recalled. By any measure, this is an outstanding performance, and one which reflects well on every member of the Firestone team.

III. Firestone Tires on the Road Today are Safe

On Monday, May 21, Firestone informed Ford Motor Company that it had no choice but to terminate its almost 100-year relationship and stop supplying tires to Ford. Firestone took this action because Ford simply refused to examine with Firestone what, if any, role the Ford Explorer had in the increased rate of tread separation claims and the subsequent rollovers that led to the catastrophic accidents. In fact, in October 2000 I sent a letter to Mr. Nasser asking his cooperation into an investigation of both the vehicle and the tire. Regrettably, Ford refused to jointly investigate the vehicle.

On May 22, Ford announced it would unilaterally recall all Wilderness AT tires fitted on Ford vehicles. We believe strongly that Ford's action is motivated by a desire to divert attention from safety concerns of the Explorer. The data from both testing and actual experience on the highways simply do not support Ford's decision. Our tires on the road today are safe, and we do not intend to participate in Ford's unnecessary and deceptively motivated action.

Ford has claimed that Wilderness AT tires have higher rates of tread separation than competitive tires. Ford would not share with us complete test data or actual claims data on competitors' tires. The data Ford did share with us shows that Ford used grossly unscientific procedures in its testing. As a result, we have done our own testing that I will summarize for you.

First, we tested "peel force," the amount of force needed to tear the two steel belts from a tire. We compared our tire with three major competitors' tires that have also been fitted to the Ford Explorer either as original equipment or a replacement tire. As this chart (#1) shows, our tires out-performed two of the three competitors' tires in this test. The results were similar when we subjected the tires to high temperatures to simulate hot climate driving. (Chart #2)

Second, we conducted SAE high speed tests in which tires are intentionally run to the point of failure on a machine that pushes tires beyond their limits. Once again, the Wilderness AT outperformed several rivals and performed well within industry norms. (Chart #3)

Third, we performed vehicle tests where our tires were run on a test track mounted on a range of compact SUVs. With this test we measured the belt-edge temperature of each tire on each vehicle after identical test cycles. (Chart #4) This test clearly shows that our tires were most heavily loaded on the Explorer. Additionally, other tests were performed on the 1997 Ford Explorer with a variety of competitor tires. The belt edge temperatures were measured and clearly show that damaging temperature increases at lower inflation pressures were greatest on the Explorer (Chart #5). These tests again revealed that the Wilderness AT is an excellent performer, better than many rival products, and well within industry norms. But these tests also further suggest an Explorer issue.

In contrast, Ford's "rig" testing is grossly unscientific and must be disregarded. First, to test our tires, Ford used aged spare tires compared with new tires from our competitors. Indeed, some of the Firestone tires tested were nine years old. It is well known that tires naturally degrade over time, regardless of whether they are used on vehicles. The rubber in tires begins to degrade as soon as it leaves the plant. When you factor out the old Firestone tires that Ford tested, and just compare our new tires with the competitors' new tires, even Ford's results show that our tires are as good as the competition! Second, Ford used surface temperature testing as opposed to internal temperature testing, the latter of which is needed to detect thermal conditions related to belt separation. No respected organization measures the surface temperature of tires to determine the likelihood of belt separation. Given these examples, it is no surprise that Ford refused to share all of its data with Firestone.

Now let's look at real world performance. A comparison of Wilderness AT performance tires fitted on the Explorer and other vehicles shows that tread separations with our tire happen disproportionately on the Explorer. We sold the same tires to Ford, designed and built to the identical specifications, for both the Explorer and the Ranger pickup truck. Claims for tread separation on the Explorer were as much as eight times greater in number than on the Ranger. (Chart #6)

These results are for the same tires on two different Ford vehicles. In fact, at the time of shipment, we do not know which of our individual tires sent to Ford are to be mounted on which vehicle. The fact that the very same tire performs so differently on these two vehicles is proof positive that there is something at work here other than a tire issue. Again, it is no wonder why Ford refused to give us production data for the Ranger for nearly six months. As soon as we received the required data from Ford this spring, <u>the data convinced us that</u>

something about the Explorer must account for the high number of tire failures and subsequent rollover accidents.

Real world claims data provide further evidence of the Explorer's extraordinary history of tread separation claims. For example, our ATX tires sold as original equipment on the Explorer were also sold as replacement tires for a broad range of similar vehicles from other manufacturers. Over seven years, there were six times as many tread separation claims for the Ford Explorer, within the replacement tire population that included other vehicles, than there were for other vehicles (claims per 100,000 tires). (Chart #7) Again, the very same tire failed at a greatly higher rate on the Explorer.

Ford also claims that its successful experience with Goodyear tires on the Explorer proves the need for its further recall of Wilderness tires. Once again, Ford has misused data to produce a conclusion that supports its false statements. For example, it directly compares Firestone and Goodyear claims without mentioning that a greater number of Firestone-equipped Explorers were shipped to hot weather states where the tires were pushed to extremes and tread separation occurred. (Chart #8) Ford states that there were only two claims for tread separation on Goodyear tires. News reports alone tell us there have been at least 13 incidents involving tread separations of Goodyear and other manufacturers' tires followed by Explorer rollover crashes. But we don't have to rely on news reports alone. Ford's own internal document – identified as Document 54 in last fall's hearing – states that Ford knew of the possibility of at least 10 tread separations on Goodyear tires (Attachment 1) and physical evidence of these separations is readily available (Attachment 2). In fact, while Ford would have you believe that tread separations are proof of defect, and that only Firestone tires experience tread separations, the reality is quite different. (Attachments 3 and 3A) All tire manufacturers, including Goodyear, acknowledge that tires are not indestructible, that tread separations are the most common form of a tire disablement and that a tread separation is not evidence of a defect.

Ford has also attempted to cloud the issue of the durability of our tires by making unsubstantiated allegations regarding construction. But again, whether it is the thickness of the wedge material at the belt edge (Chart #9) or claims about our materials, the data shows our tires are as good or better than the competition.

Ford's comparison of Firestone to Goodyear is further flawed by the inclusion of claims associated with the 6.5 million tires recalled by Firestone last year. Ford's use of claims on those tires to characterize tires on the road today is patently false and misleading.

The rationale and data put forward by Ford to explain its current recall of Wilderness AT tires is unsupported by test data, by real world experience, and by Ford's own statements about the tires. Ford's selective use of data, biased test procedures and contradictory statements show that its recall is at best a poorly documented public relations exercise designed to protect the image of a profitable product that represents approximately 1/3 of every profit dollar – the Explorer. I am deeply concerned that this campaign at Ford is also an attempt to scapegoat our tires by falsely alarming consumers about their safety. In the process, Ford may be hiding from consumers, regulators, and Congress some very real safety problems of their vehicle which should be addressed honestly and seriously.

Mr. Chairman, the extensive testing data and the voluminous record of real world performance of our tires shows that they are safe. There is no need for a recall of those tires. However, there is a need for industry and government to work together honestly to continue to improve safety for the motoring public.

IV. The Vehicle

The tire and the vehicle must be regarded as a system. We have consistently urged Congress, NHTSA, and Ford to look at this phenomenon in a balanced way – that is, to look at both the tire and the vehicle. Indeed, on October 23, 2000, I wrote Mr. Nasser a letter asking his support for a joint investigation into both the tire and the vehicle. However, Ford has refused to work with us to examine the vehicle and tire as a system. They have steadfastly urged Congress, NHTSA, and the American public to consider this strictly a tire issue and not a vehicle issue.

We have had a growing and ultimately overwhelming conviction that tire design and manufacturing issues alone simply cannot account for what has been happening with the Explorer. There is no doubt that tire failures have become relatively rare in the past few decades. Still, cars and trucks are equipped with spare tires, jacks and lug wrenches precisely because when a tire fails, for whatever reason, auto manufacturers contemplate you will be alive to change your tire when you need to. We must ask ourselves why are tire failures on the Ford Explorer all too often not a benign event, but often a catastrophic one? Why is it that, if a rear tire separates on an Explorer, the driver often loses control and crashes? We couldn't help but think that this should not be happening; a driver should be able to pull over, not roll over.

Since Ford was unwilling to participate in a joint analysis of its product, we were forced to conduct our own research into the role of the vehicle. A survey of what we have learned about the vehicle is found at Attachment 4 (Analysis of the Ford Explorer). Our root cause analysis made clear that vehicle weight and low inflation pressure are very significant factors that can lead to tread separations. The Explorer is a heavy vehicle and Ford recommended the bare minimum inflation pressure of 26 PSI. In short, Ford designed the Explorer with minimal reserve load.

As part of our root cause analysis, we learned that, in fact, in 1995, Ford increased the weight of some models of the Model Year 1996 Explorer by over 600 pounds from the initial weight when the Explorer was first introduced. (Charts #10 and #11) In this respect, it is no surprise that the 1996 Explorer is the vehicle that appears most often in the claims and lawsuits alleging a tread separation. As everyone now knows, tires can lose as much as 1 psi per month. Ford's recommendation of a 26 PSI inflation pressure diminished the load reserve of the Explorer and its tires to an unacceptable level (Chart #12). Our analysis shows that the tire inflation safety factor for the Explorer is far below that of other popular SUVs we examined.

Given the combination of a heavy vehicle with minimal inflation pressure, it stands to reason that the tire failure rate on the Explorer would be higher than on other SUVs. This is exactly what the data shows. As I stated above, the Wilderness AT tires that Ford is replacing are performing well. The relatively few claims that exist stem almost exclusively from tires fitted on Ford Explorers. Based on these facts, it is apparent that there are vehicle issues at work here.

Moreover, when a tread does separate from a tire, the separation itself ordinarily does not have a catastrophic effect on the vehicle. There is no explosion or impact that radically upsets the attitude or direction of the vehicle. Engineers think of tread separation in three phases, pre-separation, separation, and post-separation. In pre-separation, the tire becomes out-of-round due to the tread beginning to detach. The irregular shape of the tire creates a vibration in the vehicle, warning the driver that a tire failure is occurring. This ordinarily signals a driver to reduce power and beginning pulling off the road.

The separation event itself often creates a loud noise, as the tread flaps against the vehicle's bodywork before becoming entirely detached. Despite the noise, forces imparted to the vehicle are minimal. The tire casing is normally intact and remains inflated. The driver should be able to maintain control of the vehicle with very slight steering inputs. Carr Engineering, who performed tread separation tests for Ford, compared these steering inputs to those made to correct for wind gusts or when encountering water puddles on the highway. The overwhelming scientific literature agrees with Carr Engineering on this point.

In the post-separation phase, the vehicle is continuing on the roadway with three intact tires and one tire, which, while still inflated and supporting the vehicle's weight, lacks its tread. Normally, nothing catastrophic occurs here, and the driver is easily able to maintain control.

The real world data shows that with the Explorer, the occupants are at much greater risk than in comparable SUVs. An analysis of the Florida Traffic Crash Database for Explorer Model Years 1994-2000 shows that in a single-vehicle, tire-related highway accident, the Explorer rolls over at nearly four times the rate of other comparable SUVs. The rate of fatalities in single vehicle highway incidents is nearly twice that of other comparable SUVs. (Charts #13 and #14) Still additional analysis of the Florida data shows that the Explorer rolls over at nearly twice the rate of all other mid-size SUVs in single-vehicle, non-tire-related highway accidents (Chart #15). A summary of this information is contained in "Florida Crash, Rollover, and Fatal Accident Rates Based on Vehicle Registrations" at Attachment 5. These analyses clearly suggest that there is a vehicle issue at work here.

Ford's own engineering documents show that Ford was acutely aware, as early as 1981, of the critical handling requirements for sport utility vehicles such as the Explorer. Ford's experience with the rollover-prone Bronco II, the Explorer's predecessor, proved that special attention must be given to SUV handling to avoid rollovers. Ford recognized that keeping the vehicle axis parallel to the direction of travel is essential to reducing rollover accidents. Any design that allows an SUV to turn sideways to the direction of travel would greatly increase the chance for a rollover. This could be avoided by giving the driver safe handling qualities that maximize the chances of maintaining directional control.

Automotive engineers, including Ford's, intentionally incorporate a handling property called "understeer" in their vehicle design to help drivers maintain directional control.

Understeer is a forgiving, predictable, handling characteristic and its effect is to provide predictable, progressive response to steering inputs. To turn the vehicle harder, or at a higher rate of lateral acceleration, the driver need only turn the wheel farther.

The opposite of understeer is oversteer. When engineers say a vehicle is oversteering they are talking about a circumstance where the rear wheels are not tracking the front wheels and the back end of the vehicle swings around. Engineers describe an oversteer vehicle as directionally unstable. Trying to steer a directionally unstable vehicle characteristically causes it to spinout. That is a perilous position for a vehicle with a rollover tendency.

We have studied internal Ford engineering analyses of Explorer handling made throughout the vehicle's design and development. (Attachment 6) Many compromises were made to give the truck-based Explorer a softer, car-like ride, and these compromises may have also had the undesirable effect of reducing understeer and increasing significantly the amount of oversteer in the Explorer after a tire problem. The shift from understeer to a significant oversteer could cause drivers to lose control of Explorers following tread separations. The analysis of Dr. Dennis Guenther, a renowned vehicle dynamics engineer at Ohio State University who was hired by Firestone's defense counsel in October 2000, proves that this is often what happens to Explorers.

In the course of Dr. Guenther's work, it became clear that an analysis of the Explorer's handling dynamics in tread separations would help us understand why all of these accidents were occurring. In May 2001, at Firestone's request, Dr. Guenther began a series of tests of

SUV handling at the Transportation Research Center (TRC) in East Liberty, Ohio. The tests were designed to examine the controllability of the Explorer and that of comparable SUVs, following a tread separation. The tests conducted to date evaluated 1996 4x2, four-door Explorer handling compared with that of the popular Jeep Cherokee and the Chevrolet Blazer. The tests that were conducted are universally recognized, standard tests used by automobile manufacturers, including Ford. A detailed description of the tests and their results is found at Attachment 7.

The results of these tests were both enlightening and deeply disturbing. Dr. Guenther determined that with a tread separation of a rear tire, the Explorer becomes an oversteering vehicle in most situations, while the other tested SUV's maintain a safe reserve of understeer. The driver of an Explorer with four intact tires has the benefit of a small margin of understeer to provide predictable handling. When that same driver experiences an otherwise benign tread separation event, he must maintain control of a vehicle whose handling characteristics have suddenly and profoundly changed. As noted previously, the rear end of the now-oversteering vehicle has a tendency to swing toward the outside of a turn, and the driver may be completely unprepared to react appropriately. This chain-of-events typically results in a spinout, which is a perilous position for a vehicle, like the Explorer, with a rollover tendency.

The other SUVs tested by Dr. Guenther never became oversteer vehicles. Tread separation reduced the understeer of these vehicles somewhat, but there was still a significant reserve to maintain predictable handling. The differences measured are substantial. For example, the Cherokee with a separated rear tire still has more understeer than an Explorer with four good tires. (Charts #16 and #17)

As I explained, the findings of Dr. Guenther concerning the handling deficiencies of the Explorer are supported by the real world data. If we need any further proof that the Explorer's handling should be evaluated, we need look no further than Venezuela. Plagued with reports of rollover crashes in that country, Ford engineers in 1999 questioned why only their vehicles "suffer accidents" while other Firestone-shod SUVs did not. Ford, in an effort to stem the accidents, offered to sell consumers suspension upgrades to improve stability, and later replaced all Firestone tires with other brands. Even so, since May 2000, there have been 43 judicially confirmed Explorer rollover crashes in Venezuela – all of them on competitor's tires. (Chart #18) In the last 10 days alone, four people in Venezuela have died in Ford Explorer rollover accidents. The two vehicles involved in these accidents were equipped with competing tire brands. The Venezuelan Consumer protection agency has contemplated having the Explorer banned from the country.

Last fall Firestone was roundly criticized by this Committee for not acting when faced with data coming out of Venezuela and other countries. Indeed, at this Committee's urging, Congress passed the TREAD Act largely in response to that very situation. Shame on us now if, just a few months later, we ignore new data coming out of Venezuela and do not adequately investigate the Explorer. Perhaps Ford will be more responsive to requests from this Committee for accident and claims data relating to the Venezuelan Explorer rollovers – Ford has steadfastly refused to give that information to Bridgestone/Firestone.

As the Committee is aware, we took the initial findings of Dr. Guenther's research to NHTSA as soon as the tests were complete. On May 31, 2001, I met with Transportation Secretary Norman Mineta and Acting NHTSA Administrator Robert Shelton to discuss these findings. I discussed with NHTSA the need for a thorough investigation of the Ford Explorer. We did this, not because we are having a feud with Ford Motor Company. We acted because of our overriding concern for safety. We believe that to truly protect the public, safety investigations must identify and evaluate all of the factors that contribute to accidents.

V. <u>Conclusion</u>

To date, the Federal Government has focused almost solely on the tire, and we accept that scrutiny of our products. But the data and Dr. Guenther's report show that the problem is not nearly so simple. There are critical aspects of vehicle handling that contribute powerfully to the risk of rollover crashes following tread separations.

For the Committee's consideration in reviewing this matter, we have attached additional relevant data and information at Attachment 8.

We are not asking NHTSA or Congress to make a conclusive judgement based on our ongoing study. We are asking that NHTSA view this study as proof that there are vehicle issues at work here. These vehicle issues call out for scrutiny.

I want to again commend the Committee and staff for its hard work and persistence in investigating the causes of these rollover accidents. The public has a right to a thorough analysis of this problem with the full cooperation of affected companies. We have an obligation to provide that cooperation even when, and especially when, it might disclose problems with our products. Your oversight will help to assure that this occurs.

The timing of today's hearing, at the beginning of the summer driving season, provides us with an important opportunity to educate the driving public about how they can assure safe highway travel. Let me conclude by providing two recommendations from Firestone:

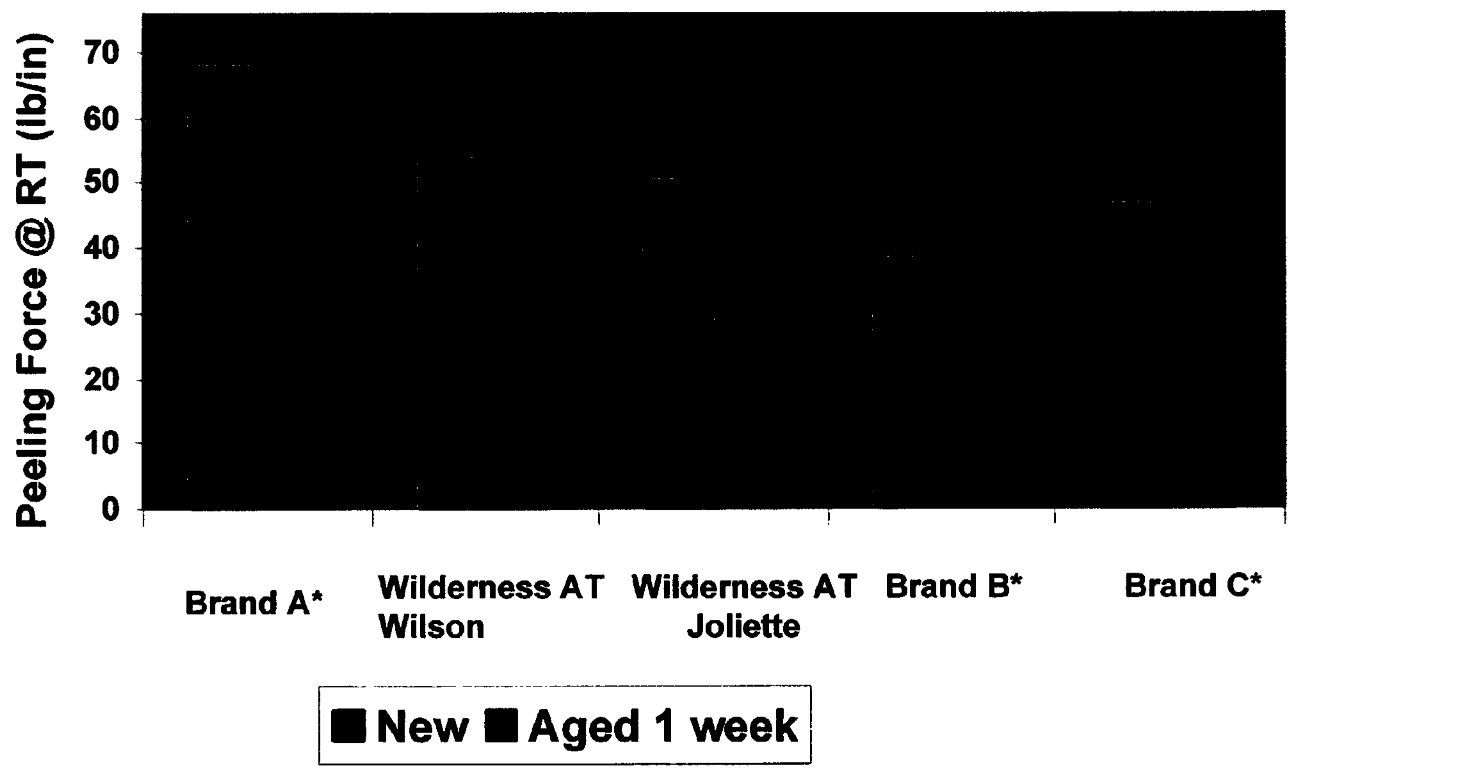
> First, do think about your tires, whatever brand they are. Make sure they are always properly inflated. And ask your tire dealer to examine them for damage if you have any doubts.
>
> Second, avoid overloading your vehicle, as this can both upset its handling and exceed the capacity of its tires. Again, the vehicle manufacturer's recommendations should be followed carefully.

Thank you again for inviting me to appear. I look forward to answering your questions.

Chart # 1

Wilderness AT tires perform better than/same as competitors' tires

Peel force test @ room temperature; tire size P235/75R15

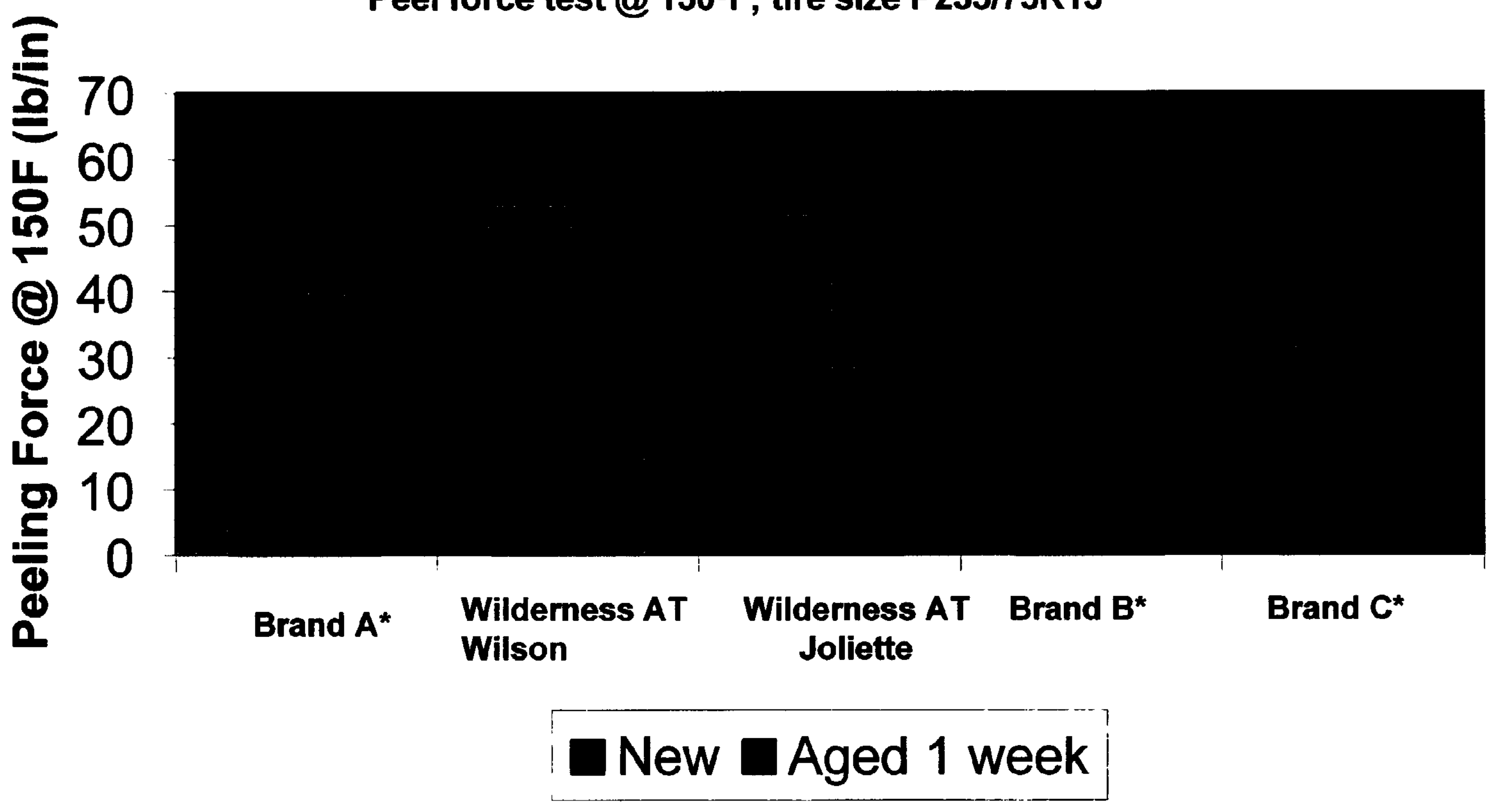


*Tires tested (in no order): Michelin, Goodyear and General

Chart #2

Wilderness AT tires perform better than/same as competitors' tires

Peel force test @ 150°F; tire size P235/75R15



*Brands tested (in no order): Michelin, Goodyear and General

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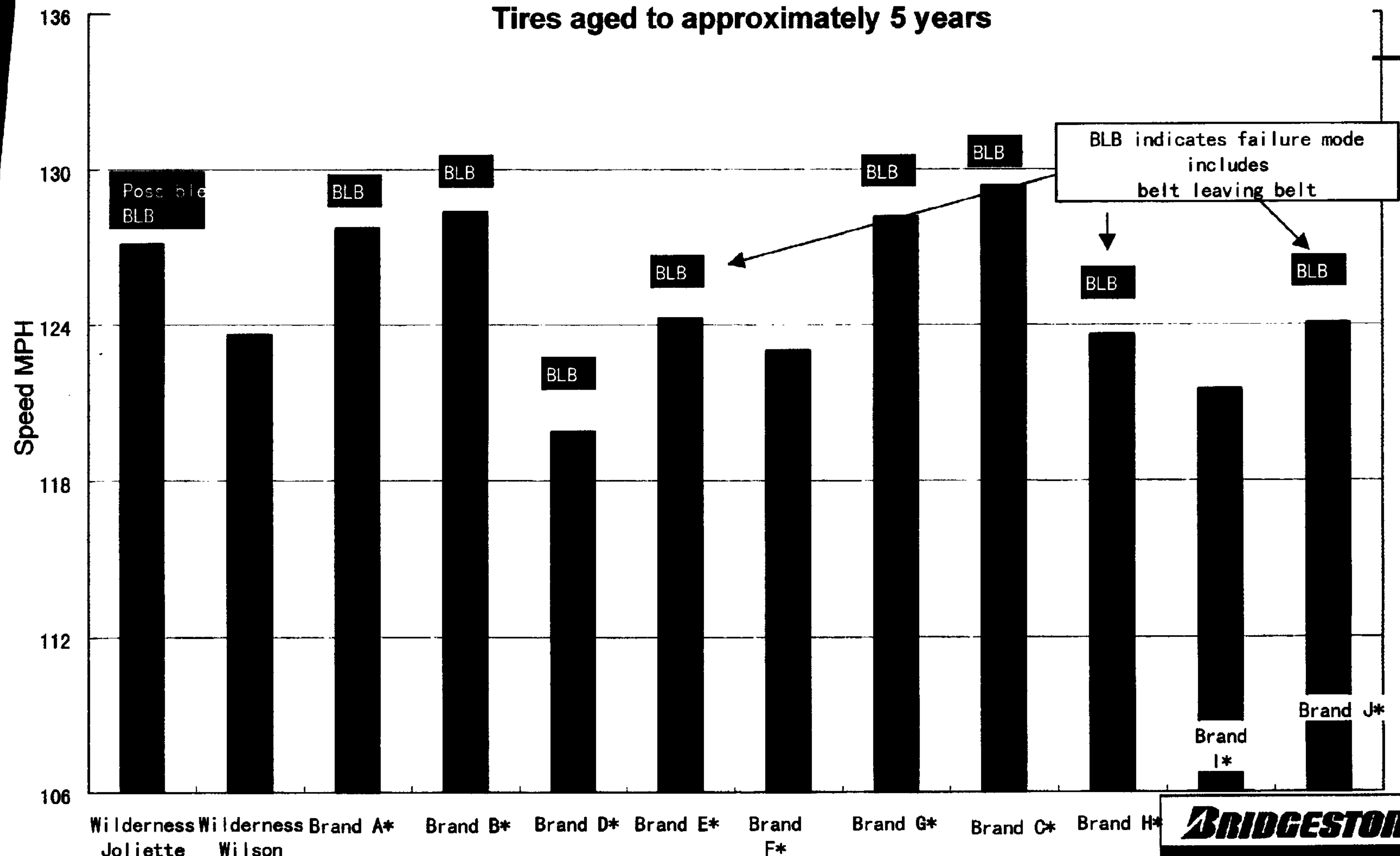
Chart #3

Wilderness AT tires perform better than/same as competitors' tires

Society of Automotive Engineers high speed test; tire size P235/75R15
Tires aged to approximately 5 years



*Tires tested (in no order): Michelin, Goodyear and General American, General Grabber, BF Goodrich, Kumho, Kelly Uniroyal, Dunlop

Chart #4

Vehicle Test

Average Rear Belt-Edge Temperature as a function of Cold Inflation Pressure / Ambient base = 100 deg F

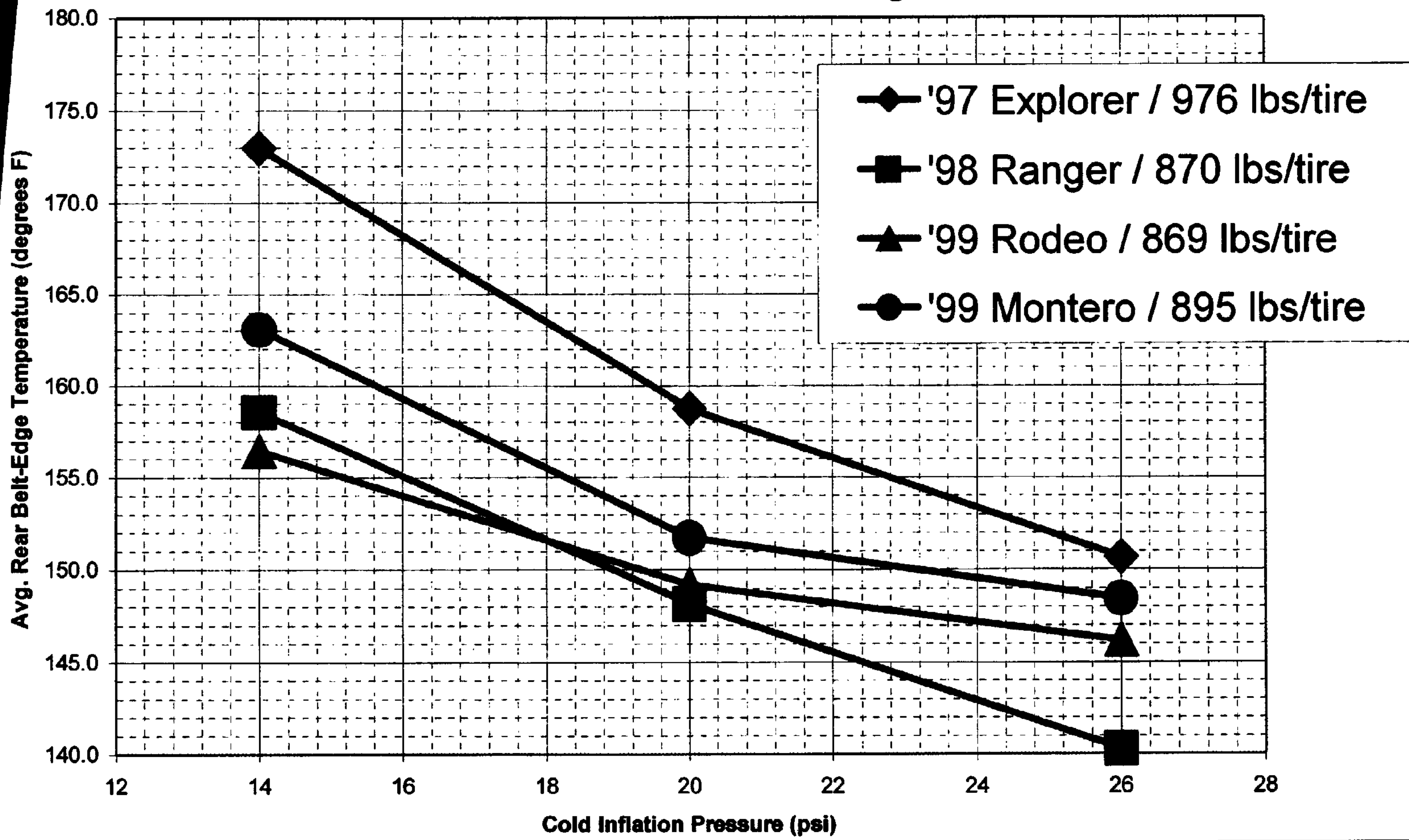


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Chart #5

Vehicle Test

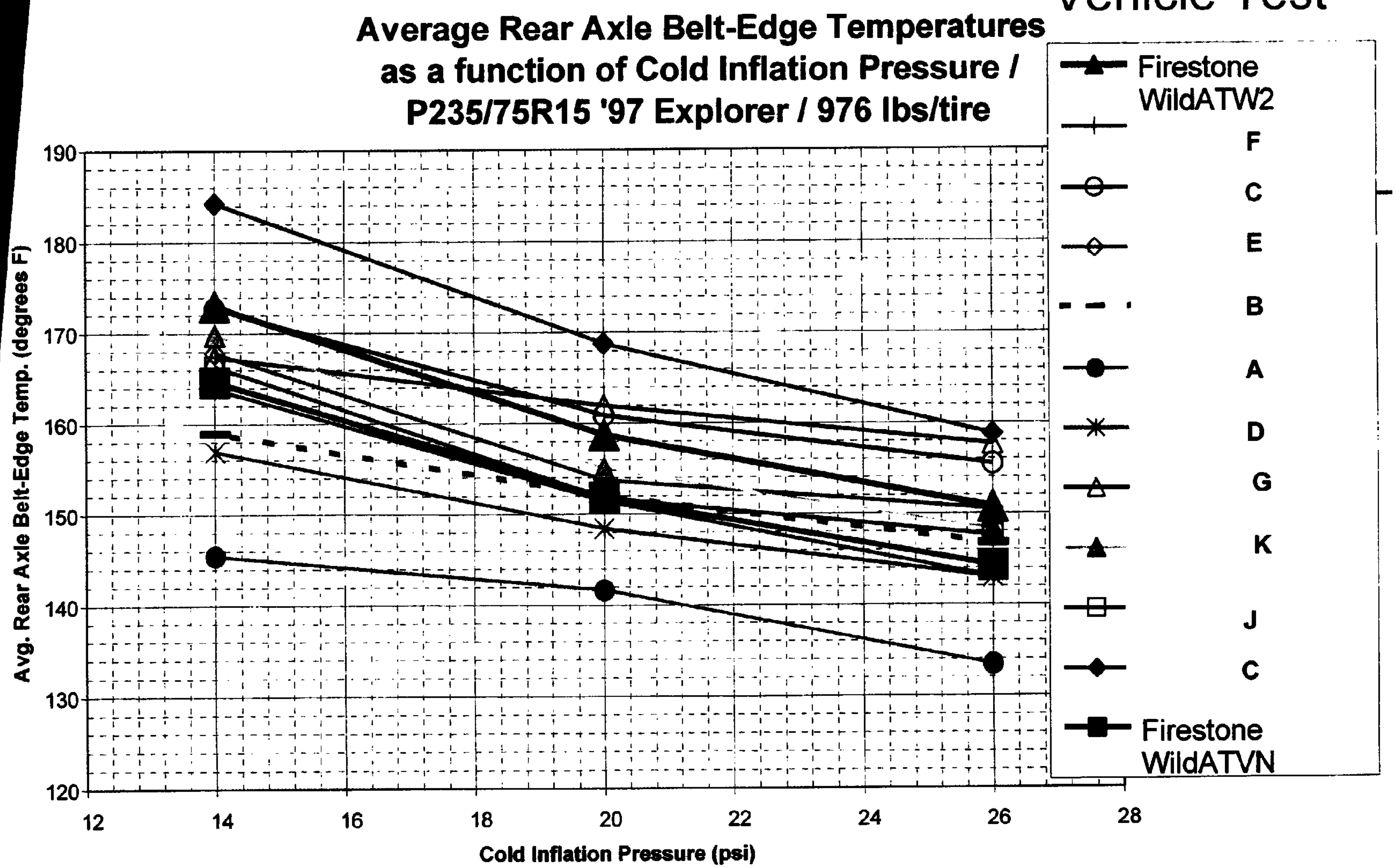

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Chart #6

Ford Explorers have as much as 8 times the Claims Rate of Ford Ranger for the Exact Same Tires

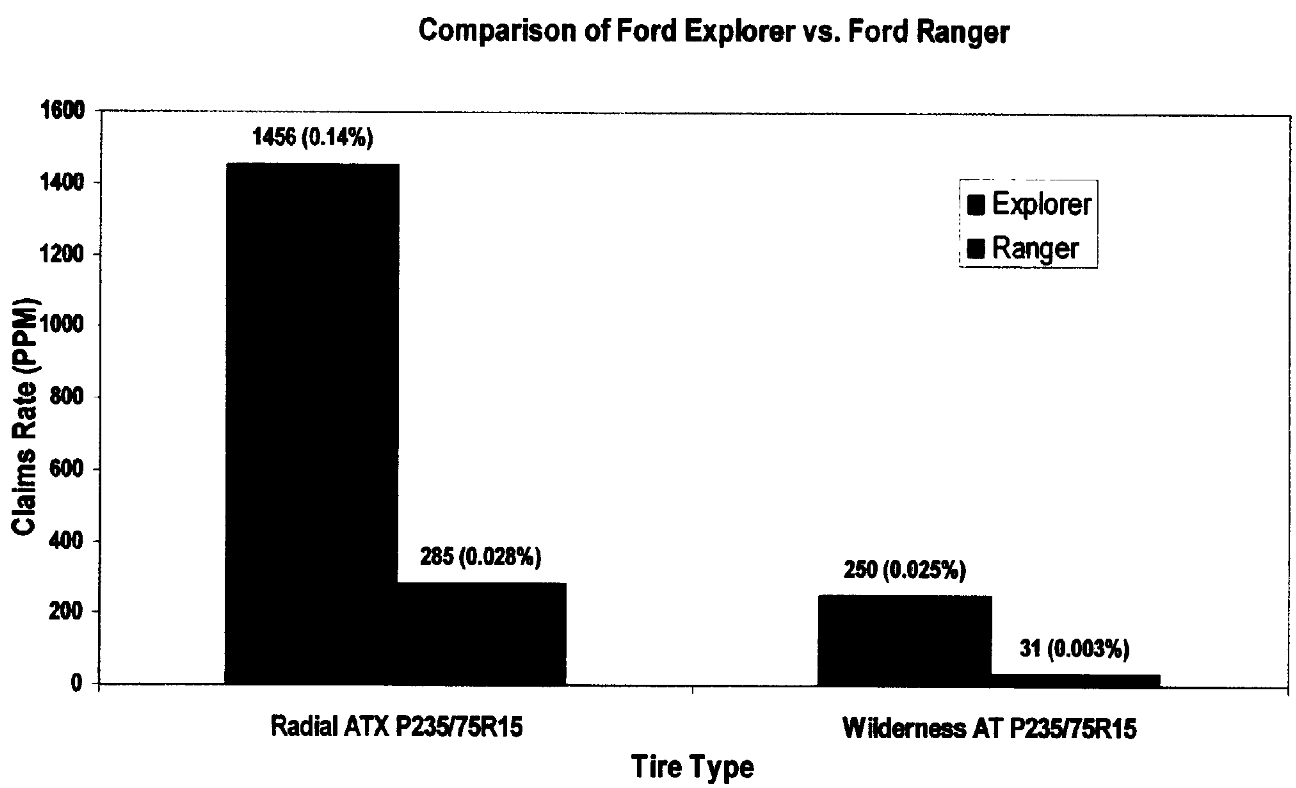

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Chart #7

OE vs. Replacement: Decatur Tread Separation Rate by Tire Age

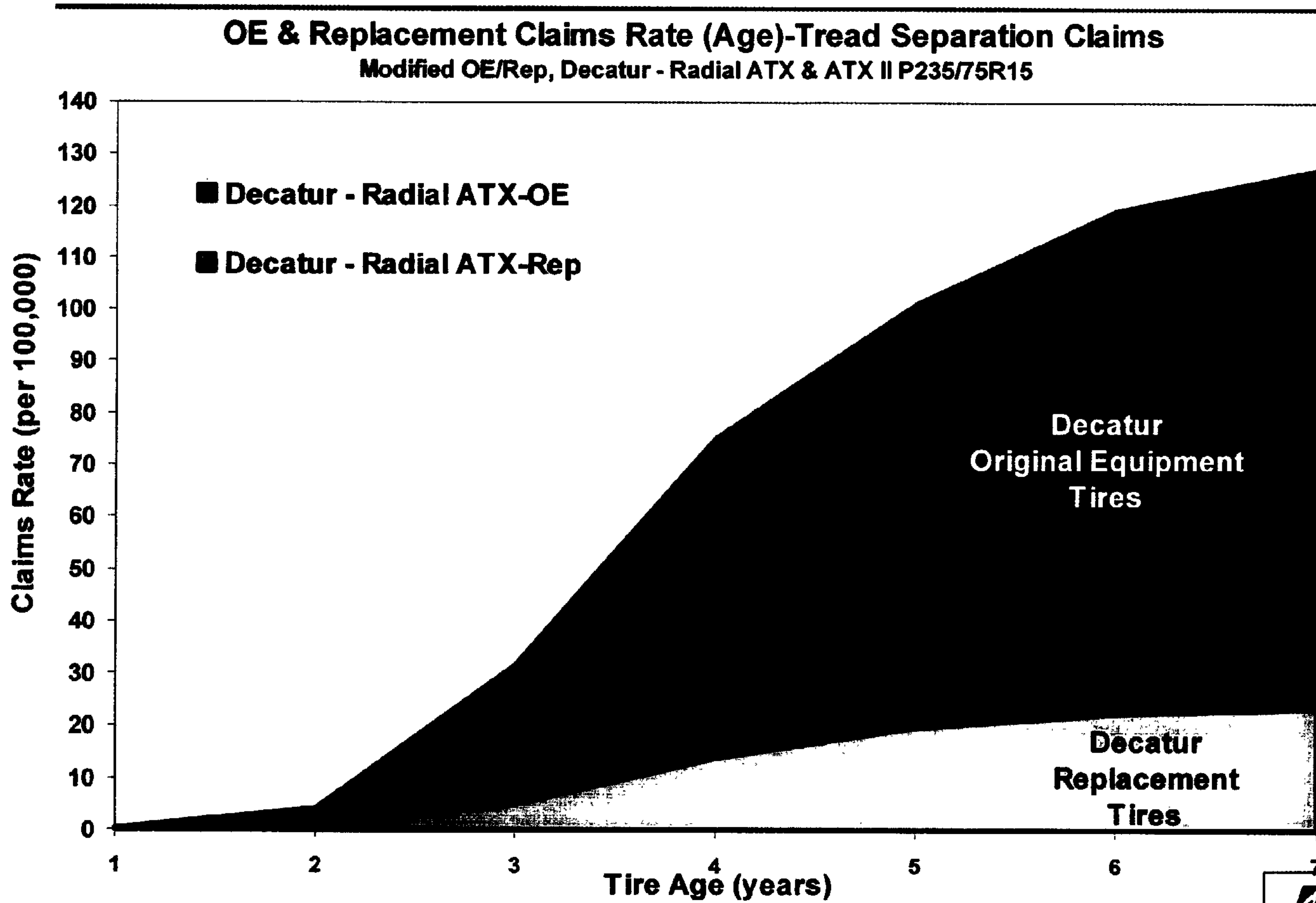
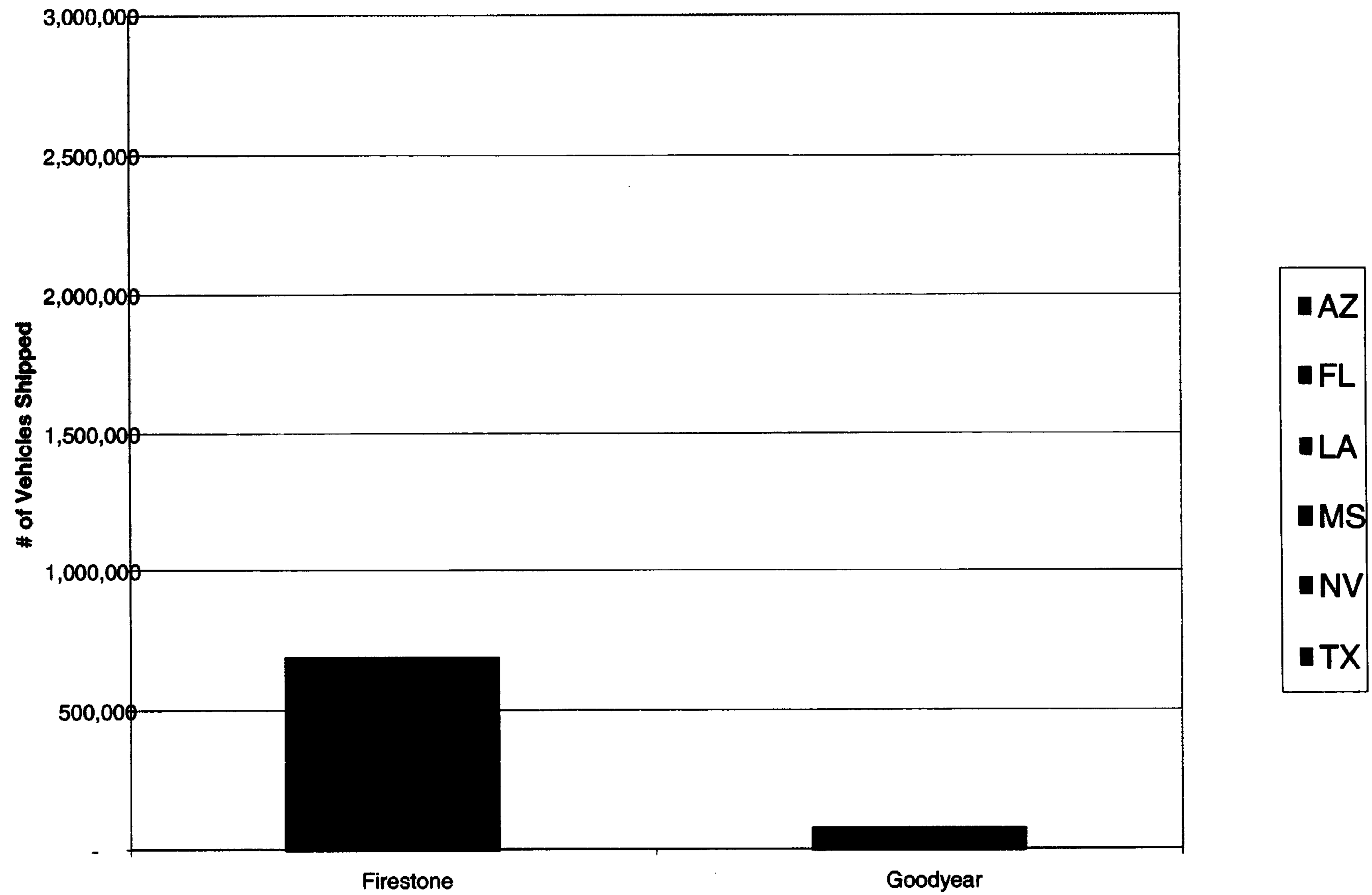


Chart #8

Goodyear vs. Firestone EXPLORER Shipments
Hot States



Attachment 1

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1. **PROBLEM DESCRIPTION**

- While driving vehicle, the tire tread separated from the main carcass of the tire. The tire failure is discovered when the driver hears the tire tread hitting the wheel house or the tire goes flat.

2. **PROBLEM STATISTICS (MAGNITUDE OF CONCERN)**

A. VOQ (Vehicle Owner Questionnaire)

-VOQ Database is showing 2 reported tire separations on 1996 vehicles. Tire size is TBD on one vehicle because of no VIN number reported and the second vehicle had the P235 tire.
-Two (2) additional tire claims that might be tire separation on 1996 vehicles. Tire size is TBD on one vehicle because of no VIN number reported and the second vehicle had the P235 tire.

B. AWS (Analytical Warranty System)

-Reviewed all 95 / 99 AWS claims (39) for tires with verbatims.

Found no reports of tire separations.

C. CQIS (Common Quality Indicator System)

-Reviewed all 95 / 99 CQIS reports (497) for tires and wheels.

Found one (1) report for Firestone tire separation; on a 1998 vehicle, but it was the Firestone P235/75R15 tire size and not the P255/70R16 tire.

D. MORS (Master Owners Relation System)

-Reviewed all 95 / 99 MORS reports (4236) for tires and wheels

Found 32 "possible" tread separation claims on Firestone (22) and Goodyear (10)

3 of the 32 possible claims were for the P225/70R15 tire from Firestone
10 of the 32 possible claims were for the P235/75R15 tire from Goodyear
18 of the 32 possible claims were for the P235/75R15 tire from Firestone

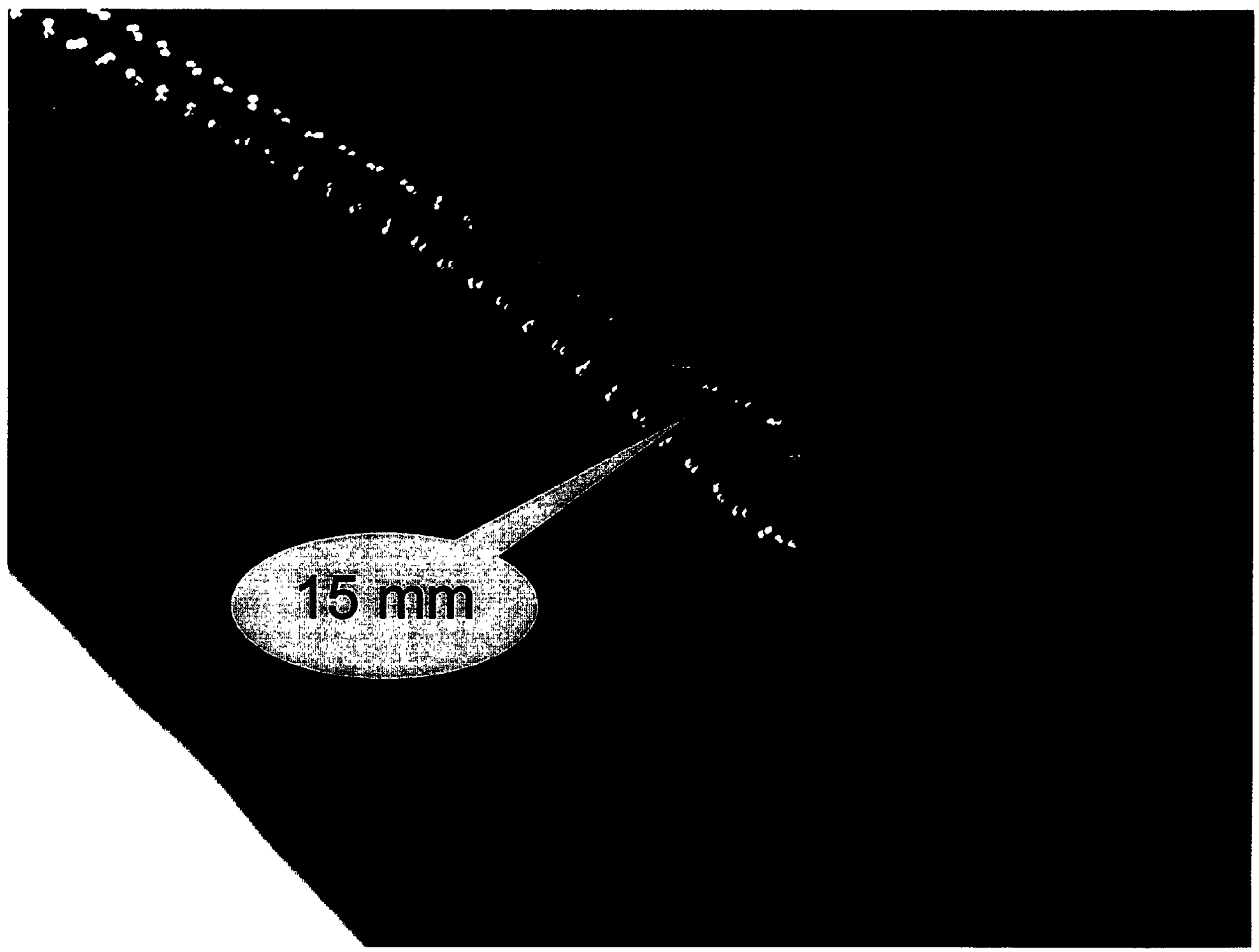
Found one (1) possible report for Firestone tire separation on P255/70R16, which sounds like it was caused by driving on a flat tire to the tire store to get air in the tire.

REDACTED

Note: Tire build dates on GCC incident tires has been between 10/25/95 and 2/19/97.

Attachment 2

Cut Tire Section Photo (4)
P235/75R15 (A) DOT365 Tread Wear 64%



Attachment 3

10/25/2000
Associated Press Newswires

"A tread separation, today the most common form of failure for a commercial tire, is normally the end result of something else that happens to a tire such as hitting a rock or other debris in the road," he said.

10/25/2000
Dow Jones News Service

..."People need to understand that tires are not indestructible. Most commonly, tread separation results because the tire is damaged when it strikes an obstacle in the road, not because of intrinsic flaws."

10/25/2000
AFX News

"All tires can separate. Tread separations do not necessarily indicate a defect in a tire."

"As vehicle owners, you need to understand that tires do fail, and they do separate. They cannot be made indestructible. Tread separation is the most common form of failure for all light commercial tires regardless of who manufacturers them. But tread separation does not necessarily indicate a defect in a tire."

Attachment 3A

10/25/2000
Associated Press Newswires

"A tread separation, today the most common form of failure for a commercial tire, is normally the end result of something else that happens to a tire such as hitting a rock or other debris in the road," he said.

(Joseph M. Gingo, Goodyear senior vice president for technology and global products planning, in response to tread separation questions about Goodyear Wrangler AT and HT tires)

10/25/2000
Dow Jones News Service

..."People need to understand that tires are not indestructible. Most commonly, tread separation results because the tire is damaged when it strikes an obstacle in the road, not because of intrinsic flaws."

(Statement released by Goodyear Tire & Rubber Co. in response to tread separation questions about its Wrangler AT and HT tires)

10/25/2000
AFX News

"All tires can separate. Tread separations do not necessarily indicate a defect in a tire."

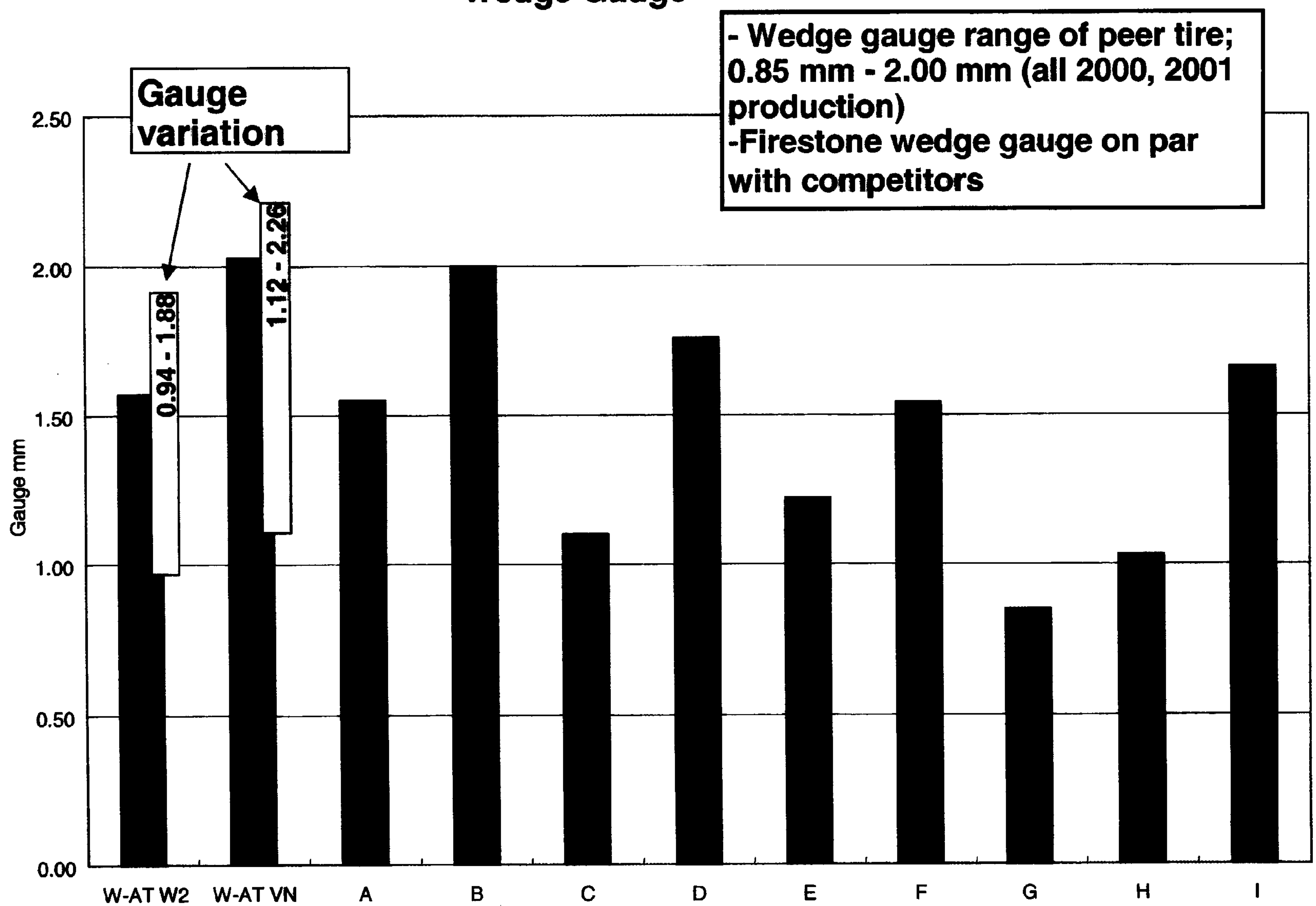
(Statement released by Goodyear Tire & Rubber Co. in response tread separation questions about its Wrangler AT and HT tires)

"As vehicle owners, you need to understand that tires do fail, and they do separate. They cannot be made indestructible. Tread separation is the most common form of failure for all light commercial tires regardless of who manufacturers them. But tread separation does not necessarily indicate a defect in a tire."

(Letter to Goodyear customers from John C. Polhemus, President, Goodyear North American Tire, 10/27/2000)

Chart #9

Wedge Gauge



Competitors' tires tested: Continental, Cooper, Dunlop, General, Goodyear, Kelly, Kumho, Michelin, Uniroyal

Attachment 4

ANALYSIS OF THE FORD EXPLORER

I. Executive Summary and Introduction

The purpose of this analysis is to address the myth with respect to the Ford Explorer that rollover crashes that occur following a tread separation are attributable in any way to tire design or tire manufacturing. In fact, as the data presented in this analysis conclusively demonstrate, tire issues can not account for the high risk and rate of Ford Explorer rollover crashes. This analysis concludes that, based on the design and development of the Explorer, real world data on Explorer control problems, an engineering analysis of the Explorer, and the substance of Ford's own presentation to NHTSA concerning Explorer vehicle dynamics, the rollover problem is rooted in the Explorer, not tires.

A. Design and Development

For 20 years Ford engineers have known that so-called "understeer" is the primary vehicle design factor that prevents vehicle rollover and that an "oversteering" vehicle can and likely will result in loss of control that foreseeably could lead to a rollover and other accidents. In fact, Ford engineers recommended to management major changes to the suspension, engine height and track width of the Explorer to increase understeer in all conditions and to increased Explorer rollover resistance. Ford management ignored or rejected these recommendations.

Instead, Ford decided to create a public relations "image" for the Explorer as a safe vehicle. The Company manipulated the rollout of the Explorer, including its design and testing, solely to get the new vehicle to "look" or "seem" like it was stable, and regardless of the effect such manipulations might have on controllability. By putting profits and public relations image in front of sound engineering principles, Ford caused two catastrophic consequences. First, Ford reduced the margin of safety for tires that it specified to Firestone, causing the rare but now highly publicized phenomenon of tread separations on Explorers. Second, because of the vehicle's design, the Explorer, following a tread separation, immediately transitions to an oversteer truck that is likely to go out of control and roll over. Ford's flawed decisions are confirmed by real world data.

B. Real World Data

As the following data suggest, the Explorer rollover problem is not a case of a "bad tire," but of a vehicle control problem:

1) Wilderness AT 15" tires provided to General Motors and not recalled last year have only 2 tread separation claims on 3.1 million tires.

2) The non-recalled Wilderness AT 15" tires have a tread separation claims rate eight times higher on the Explorer than on the Ford Ranger. The tires on each are exactly the same.

3) The total number of tread separation claims and lawsuits for the 13 million tires Ford is replacing is 118, less than 10 parts per million or 0.0009%, which provides no rationale, other than a suspect one, for Ford's $3 billion replacement campaign.

4) Based on the Florida Traffic Crash Database, the odds of an Explorer rolling over in a single-vehicle highway tire-related incident are 4.35 compared to 1.92 odds for comparable SUVs. The odds ratio of a fatality occurring in such an accident is nearly three times greater with the Explorer according to Florida data, and four times greater according to Texas data.

This data proves that the Explorer, in single vehicle, tire related highway incidents simply does not perform as safely as its competitors, which is confirmed and explained by the recent engineering analysis conducted by Dr. Dennis A. Guenther.

C. Engineering Analysis

According to a recent engineering analysis conducted by Dr. Dennis A. Guenther, a Professor of Mechanical Engineering at Ohio State University, the Explorer is often an oversteer vehicle after it experiences tread separation, which makes the Explorer vehicle directionally unstable and subject to loss of control in the hands of most drivers. Dr. Guenther's analysis found that:

1) Explorer models he has tested, as designed, have a significantly lower amount of understeer – less than half as much – than the other SUVs he evaluated.

2) The Explorer loses much of its small margin of understeer when it is loaded to gross vehicle weight rating – the other SUVs do not.

3) The Explorer models tested, unlike other SUVs tested, lose all of their understeer and become oversteer vehicles in most circumstances following tread separation on a left rear tire, the predominant tire position in Explorer tread separation crashes the other SUVs do not.

4) An oversteer vehicle is extremely difficult for most drivers to control, particularly at interstate highway speeds where it can become directionally unstable.

Dr. Guenther concludes that the oversteer problem in the Explorer should be reported as a safety defect within the meaning of the National Highway Traffic and Motor Vehicle Safety Act. Ford Explorer rollover phenomenon is the result of a vehicle problem not a tire problem, and should be regarded as a safety defect within the meaning of the National Highway Traffic and Motor Vehicle Safety Act.

D. Misleading Ford Filing to NHTSA

Ford's March 2001 filing with the NHTSA concerning the Explorer's loss of control following a tread separation contains inaccuracies and misinformation that reinforces Ford's irresponsible reaction to the rollover problem, as the following component of that filing suggests.

Ford suggested in its filing to the NHTSA that tread separation is a "fundamental cause" of loss of vehicle control that "overwhelms differences in design among vehicle claims or within vehicle classes," and that, in this setting, "Explorers perform like all other vehicles." Ford based that statement, however, on a so-called high lateral acceleration maneuver, ***where most drivers do not operate their vehicles***. In fact, the maneuver most often used to correct for the small event of drag following a tread separation or in bringing a vehicle to the shoulder is a very small steer input resulting in a so-called low lateral acceleration maneuver, even at highway speeds. In such a normal driving maneuver, Explorers do not perform like other vehicles, since they lack the necessary margin of understeer to remain directionally controllable in highway maneuvers involved in normal driving.

E. Conclusion

Taken together, these factors provide disturbing evidence that Ford, when given the opportunity to act responsibly to ensure the safety and stability of the Explorer, has acted instead to shift blame and obfuscate the facts concerning the safety of its best selling vehicle. As the following analysis confirms, the rollover phenomenon is a vehicle problem that requires forthright and responsible investigation.

II. Design and Development of the Explorer

A. Introduction

Ford engineers have known for over 20 years that the most important vehicle characteristic in maintaining control and reducing SUV propensity for rollover is understeer. The company's engineering documents identify understeer as a "first order effect" and the "primary factor influencing roll-over propensity."[1] The problem with an oversteering vehicle, in terms of rollover propensity, is that it can and likely will result in the back end of the vehicle coming around—a loss of control—with the vehicle ending up sideways to its path of travel. The resultant side forces ("lateral acceleration" in engineering terms) are what bring about rollover.[2]

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1 Ford Program Report 000000393-98, "Roll Over Stability," February 3, 1981.

2 Id.

Ford also recognized that the rollover stability of a vehicle is affected by its stability index, the relationship of center of gravity height and the track width of the vehicle. In light of these vehicle control and stability principles, Ford engineers adopted a "handling strategy" with respect to the Explorer to "increase understeer in all conditions",[3] and they recommended to Ford management major changes to the suspension, reduction in the engine height to lower center of gravity, and increase in the track width of the vehicle to make the Explorer more resistant to rollover than the Bronco II.[4]

Ford's knowledge of the critical importance of understeer was not acted upon, however, and Ford management rejected the center of gravity and track width recommendations of its engineers that would have made the Explorer more resistant to rollover.

Rather than doing what good engineering required to make the Explorer safe, with an acceptable margin of control Ford decided on a course of creating a public relations "image" for the Explorer as a safe vehicle. It did this by making a vehicle that could pass so-called "J-Turn" and "Consumer Union" lane change tests, even though it knew and took the position internally that the maneuvers in those tests were "not representative of what is happening in the real world."[5] It also decided to rely on the less aggressive driving habits of members of the family car market into which it sold the Explorer to give the vehicle a statistics-based "image" of rollover safety in spite of the stability shortcomings of the vehicle.[6]

Unfortunately for Firestone's reputation, Ford carried out the design tradeoffs and manipulations required for the public relations image it sought primarily by letting air out of the

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3 Ford engineering document EXP3 1107, "Subject: UN46 Handling/Stability Status."

4 Ford engineering document EXP4 1581-84, "Proposed UN-46 Chassis Design Modifications."

5 Ford document EXPI 0622, email from White to Houston, September 11, 1989.

Explorer's tires. In a 1989 Development Report on "Suspension Development Status," after noting that they had investigated variations in tire pressure "as means to achieving the UN46 [Explorer] ride and handling objective," Ford engineers recommended use of "reductions in tire pressure to meet the program objectives" for both ride and handling.[7]

Similarly, in addressing rollover stability, Ford engineers adopted a "strategy" of limiting cornering capacity of the large tires demanded by the Ford marketing department by, again, reducing air pressure.[8]

When it came to creating understeer, the Ford engineers again turned to lower tire pressure.[9]

By putting profits and public relations image in front of sound engineering principles, Ford caused two catastrophic consequences. First, Ford reduced the margin of safety for the tires that it specified to Firestone, contributing to the rare but now highly publicized phenomenon of tread separations on Explorers. Second, because of the vehicle's design, the Explorer, following a rear tire tread separation, immediately transitions to an oversteer truck that is likely to go out of control and roll over in the hands of the ordinary driver.

B. Development of the Explorer

1. Initial Design Flaws Based on Bronco II and Tire Manipulations

Ford's internal documents describe the Explorer as a new and freshened Bronco II. Ford initially intended to continue using the Bronco II name, but decided to change the name to

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(...continued)

6 Ford engineering document EXP3 1108, "Subject: 1990 Explorer Handling Stability."

7 Ford engineering document EXPU 1458-60, "Development Report." See also, Ford engineering document EXPT 1497-1503, "Development Report."

8 See, e.g., Ford engineering document EXP4 1273-74, "Subject: UN46 status."

Explorer when the Bronco II came under fire for rollover problems and Ford sought to distance itself from criticisms of the Bronco II.[10]

As early as 1986, Ford engineers started playing with tire sizes to address rollover stability, rather than making more fundamental changes in their vehicles. Ford engineers labeled the P195 tires as the "base tire" on the Bronco II to achieve a satisfactory "stability index" because the Bronco II with P215 tires, which it sold as an option tire on the Bronco II, could not pass Ford's rollover stability tests.[11] One Ford engineer questioned this approach: "Shouldn't we be looking at more permanent ways of improving the stability index of Bronco II other than small tires?"[12] Another Ford engineering document explained that the company chose to play with tire size rather than spend the time and money to create a truly safer vehicle:

> Stability index requirements are always tied to base vehicle (this decision was reached with help of OGC [Office of the General Counsel]). Since the P215 pushes the stability index below the accepted minimum of 2.1, the suspension guys felt they need to retain a tire that has the minimum S.I. Better alternatives to tire size are for example
> - lowering vehicle
> - lowering CG by adding weight low in vehicle
>
> Cost and timing implications of these kind of actions have always stalled them in their tracks to White.[13]

In designing the Explorer, Ford stuck with the basic Bronco II frame and suspension, and utilized the same philosophy of playing with tires to address rollover stability concerns. As a result, the Explorer shared virtually the same track width, high engine mount, obsolete

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(...continued)

9 See, e.g., Ford engineering document EXP4 0193, "UN46 Analysis." See also Id.

10 See, e.g., Ford media relations document EXP4 1280-84, "Explorer Q&A."

11 See Ford document 000012766-67, memorandum from Snodgrass to Bacigalupi and Vought, September 3, 1986.See also note 5.

12 See Ford document 000012765, memorandum from Bacigalupi to Snodgrass, September 5, 1986.

13 Ford document 000008940, memorandum from Bacigalupi to White, October 6, 1986.

suspension, and elevated center of gravity as its parent vehicle, the Bronco II. "[G]iven the fundamental constraints imposed by the vehicle package and suspension 'type'" carried over from the Bronco II, Ford struggled to reduce the Explorer's rollover propensity;[14] most of Ford's struggles involved specifying the tires rather than changing the vehicle.

2. Explorer Testing – Unrealistic Measure of Vehicle Safety

Ford required that the Explorer pass "J-Turn tests," an unrealistic maneuver invented by the Insurance Institute for Highway Safety in the early 1980s, before being released for production.[15] A "J-Turn test" is an extreme turn at a given rate speed (usually 45 or 60 mph), and an evaluation of whether the vehicle's tires lift off the ground. In addition, while not a formal requirement, the Consumer Union's lane-change rollover stability test "became an implicit requirement for the Explorer due to the potential for adverse publicity" if it failed.[16]

Because of these image and litigation-driven requirements, the development of the Explorer turned into a story of tweaking the vehicle and the tires in an attempt to pass these tests, while at the same time providing a softer rider acceptable to Ford's target marketing group – families. Even though Ford's internal documents had identified understeer as the most important vehicle handling characteristic in maintaining directional control and reducing rollover exposure,[17] the design tradeoffs made by Ford to pass J-Turn and Consumer Union tests did not address or seek to increase understeer and the degradation they caused in the vehicles control charicteristics.

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14 See note 6.

15 Id.

16 Id.

17 See note 1.

In late 1988, more than a year before the Explorer's spring 1990 introduction, computer modeling showed that "the vehicle still has 2 wheel lift no matter what tire is on it, 225/70, 215/75 or 205/75."[18] In February 1989, the computer simulation continued to show unacceptable rollover performance with certain P245 and P225 tires.[19] The result remained poor in computer simulations after lowering the rear of the vehicle by one-half inch with 26 psi in the tires.[20]

Undeterred by these results, Ford management concluded in late February 1989 that with 26 psi in the P235 and P245 tires, and tweaks to the suspension, stabilizer bar and a one-half inch reduction in rear ride height, the Explorer would meet its handling objectives.[21]

Ford then tried every trick in the book to get the vehicle to pass the J-turn test, including in one March 1989 simulation placing all four test dummies on the vehicle's floor to lower the vehicle's center of gravity. The Explorer still failed the test.[22] Later in March 1989, the Explorer failed J-Turn tests with a variety of tire pressure and suspension configurations.[23] At one point, it was proposed that if the marketing implications were not too great, the P225 tire be the largest tire allowed on the vehicle and that the maximum load allowed for the vehicle be reduced.[24] Even in August 1989, the Explorer failed J-Turn tests at its Arizona proving grounds with 35 psi in the P235 tires.[25]

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18 Ford document EXPT 1047-49, memorandum from Figliomeni to Avouris, November 29, 1988.

19 Ford document EXPU 1959, memorandum from Figliomeni to Avouris, February 3, 1989.

20 Ford document EXP7 2273, memorandum from Figliomeni to Avouris [undated].

21 Ford document EXPU 9476-78, "Development Report."

22 See Ford document EXPT 1168, email from Avouris to Campbell, March 8, 1989.

23 Ford document EXP4 1276, memorandum from Starr to Avouris and Campbell, May 10, 1989.

24 See Ford document EXPT 0785-86, "UN46 Development Status."; see also Ford document EXPT 0569, "Subject: 1990½ UN-46 Chassis Revisions and Tire Availability," July 6, 1989.

25 See deposition of Thomas B. Baughman in Bailey v. Ford Motor Company, at 78-81.

Concerned over the Explorer's struggling performance in rollover stability tests, in June 1989 Ford management actively considered releasing the 4-door Explorer on P225 tires as a "strawman" because it would pass the Consumer Union test with those tires, though not with P235 tires. Six months later, after the "strawman" passed the test, Ford could quietly release the 2-door and 4-door on P235 tires.[26] Thus, Ford cynically manipulated not only the design of the Explorer, but also the testing, solely to get the new Explorer to "look" or "seem" like it was stable, regardless of whether it really was or not and regardless of the effect such manipulations might have the margin of safe controllability.

3. Manipulative Marketing

Ford not only manipulated the design of the Explorer to make the vehicle seem like it was rollover resistant but also to make it seem to the consumer something it was not -- a passenger car.[27] The Explorer is in fact a "Light Truck" derived from the Bronco II and Ranger trucks, not a passenger car. Nevertheless, driven by its intense marketing determination to get suburban "soccer moms" to buy and drive the vehicle, Ford imposed upon the vehicle design a passenger-car-like ride.[28] Ford accomplished this by, among other things, softening the suspension, using a P-metric (passenger car) tire, and taking air out of the tires.[29] Knowing that this passenger-car-like vehicle would be just as likely to roll over as the Bronco II, Ford intentionally designed excessive body roll into it to act as a deterrent to the driver against making sharp turns that might

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26 See Ford document EXPT 0570-71, email from Stomant to Campbell, June 23, 1989.

27 See, e.g., Ford document EXP2 1578, "Inter-office Memorandum," June 9, 1987.

28 See, e.g., Ford document EXPN 0175, at 0180-81, "Dealer Launch and Resource Guide."; Ford document 000057450-52, Ford press release.

29 See, e.g.,note 24.

result in rollover.[30] This change was made even though the relatively low damping of body roll adversely affects controllability of the Explorer. This change, coupled with Ford's other design tradeoffs intended to provide a vehicle more resistant to rollover allegations rather than to improve safety, ultimately resulted in the sacrifice of the amount of understeer and other contributions to a proper formation of controllability necessary to provide reasonable consumer safety in foreseeable tire failure circumstances.

4. Flawed Tire Decisions

In the fall of 1989, an engineer warned that the Office of the General Counsel of Ford was "arming themselves for one more attempt to . . . restrict [the Explorer] to P225 tires."[31] Obviously, the attempt by the lawyers to address a safety issue failed. Ford sold the Explorer with optional P235 tires.

Ford engineering documents summarize the Explorer's twisted development history by conceding failure:

> The 1990 Explorer has been designed to achieve the best possible handling stability given the fundamental constraints imposed by the vehicle package and suspension "type"..... To achieve the stated [stability] values, the Explorer has been lowered to the maximum extent possible. The relatively high engine position of the Explorer, unchanged from Bronco II, prevents further significant improvement in Stability Index without extensive suspension, frame and sheetmetal revisions.[32]

Ford recognized that the Explorer, particularly the 2-door with P235 tires likely would fail the Consumer Union test.[33]

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30 See, e.g., note 3.

31 Ford document EXP 0625, email from Stornant to White, September 11, 1989.

32 Ford engineering document EXP3 1108, "Subject: 1990 Explorer Handling Stability."

33 Id.

With all of Ford's design manipulations to achieve the appearance of rollover stability, the Explorer nevertheless remained an unstable vehicle when it was sold to the public beginning in 1990. Both computer simulations and Ford's actual testing in 1989 showed that the 2-door Explorer with P235 tires was as unstable as the highly criticized Bronco II, and the 4-door was only slightly better.[34] When Ford engineers recommended major changes to the front suspension, steering system, and rollover stability dimensions in order to make the vehicle as resistant to rollover as they knew it needed to be, management rejected the proposals because they would interfere with "Job 1." Internally, "Job 1" at Ford meant meeting the March 1990 initial production date.[35] Ford reasoned that even though it did not make needed fundamental changes to the Explorer in development, it would still perform better than the Bronco II in rollover statistics because of the longer wheelbase and increased understeer (largely from reduced tire pressure) and more conservative drivers. "With the high (80/20) mix of 4dr vehicles, we can expect a less aggressive driver profile with a corresponding reduction in all accident statistics."[36] Ford internal documents show that Ford management blithely "accepted [the] risk" that the Explorer would have a higher rollover risk with the larger P235 tire.[37]

Ford also blithely "accepted the risk" that the vehicle would become uncontrollable in foreseeable circumstances, such as tire failures. As Ford recently admitted to NHTSA,[38] it simply chose not to test to determine how much tire tread/belt separation, which it admitted to be

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34 See, e.g., Ford email EXPI 0619-20, email from Stornant to White, September 12, 1989.

35 See note 4.

36 Ford engineering document EXP3 1108, "Subject: 1990 Explorer Handling Stability."

37 See note 34.

38 Ford document, "Firestone Tire Root Cause Update and Explorer Vehicle Dynamics Presentation," March 28-29, 2001, at page TH-3 132.

foreseeable, would reduce understeer and controllability and thus lead to unnecessary accidents. Ford failed to do such testing even though it knew from tire testing it had done and decades of use of numerous tire brands on the cars it manufactured that tire tread/belt separations could occur with the tires to be used on the Explorer. Contrary to Ford's assertions in the March NHTSA presentation, there was nothing about the Explorer design that was intended to or did ensure vehicle controllability in the event of tread separation.

C. The Weight of the Explorer Further Stresses the Tires

That Ford took air out of the tires to increase the Explorer's rollover stability cannot be reasonably disputed. Nor can it be disputed that weight – i.e., the load placed on tires – is a factor in tire life. Dr. Sanjay Govindjee from the University of California at Berkeley established that vehicle loading is a very significant factor leading to tread belt separations.[39] It also cannot be disputed that at 26 psi, Ford left a very small leading margin for safety in the tires.

The P235 tire at 26 psi on the Explorer has a margin for safety in terms of weight of about 150 pounds. At 23 psi, that tire on several versions of the Explorer has reached its maximum load at the GAWR of the vehicle.[40] Below 23 psi, the tire would be overloaded. In fact, through 1996, Ford continually added weight to the Explorer. The 1990 4x4 4-door increased from about 5,000 pounds to nearly 5,400 pounds in 1993 to well over 5,600 pounds in 1996. It is no surprise that a significant majority of the claims that Firestone has received is on the heavier Explorers.

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39 See Firestone Tire Failure Analysis, Dr. Sanjay Govindjee, January 30, 2001, at 35.

40 See attached chart.

In fact, the Explorer has an extremely low tire inflation safety factor relative to other popular SUVs.[41]

The bottom line is that Ford placed too much on the tires. It set the specifications for the tires and Firestone met those specifications. But Ford also reduced the tire pressure to the minimum so the inherently unstable Explorer could pass, just barely, internal J-Turn tests, and so the light truck would ride more like a car to attract family drivers. At the same time, Ford designed a heavy (and for that matter, top heavy) vehicle, and then continued to make the vehicle heavier. No wonder that the combination of low or in many cases under inflated tires with heavy loaded vehicles in the hot summer lead to an increase in tread separations.

Not surprisingly, the real world data shows that this is more than just theory.

III. <u>The Real World Data Show the Explorer Has A Control Problem</u>

Not only do Ford's internal documents show that the Explorer's designers ignored what they knew about the relationship of understeer and vehicle control, the real world facts support the conclusion that this is not a case of a "bad tire," as Ford's Chairman Nasser has asserted, but a vehicle with a control problem:

1. Of the 2.6 million Wilderness AT 15" tires not supplied last year and recalled to General Motors, there are only 2 tread separation claims --- less than 1 ppm!.

2. The non-recalled Wilderness AT 15" tires supplied to Ford have a tread separation claims rate 8 times higher on the Explorer than on the Ford Ranger. The tires on each vehicle are exactly the same.

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41 <u>See</u> attached chart.

3. As of the end of 2000, the total number of tread separation claims and lawsuits for the 13 million tires that Ford is replacing is 118. That is, less than 10 parts per million or 0.0009%. This is incredibly low. Ford's announcement to replace these tires is itself suspect. No rational automobile company in the world would spend $3 billion to address a "problem" that doesn't exist.

4. Just a few weeks ago, there was a report of a Ford Explorer accident in Ft. Myers, Fla. According to the report, a BF Goodrich tire on the left rear separated, the driver then lost control, and the vehicle ultimately rolled over, killing the driver. In the newspaper report, the state trooper on the scene stated that a tread separation does not ordinarily mean that you lose control of the vehicle.

5. In Venezuela, there are reports of 43 rollover accidents on Explorers between May 2000 and June of this year. All are Goodyear or other competitor tires. This rate of rollovers has prompted the Venezuelan Consumer Protection Agency to consider that Explorers be banned from the country. In fact, in the last 10 days alone, four people have died in 2 separate Ford Explorer rollovers; both of the accidents were on competitor tires.

6. Finally, the crash data itself shows the stability problems in the Explorer. Based on the Florida Traffic Crash Database, the odds of an Explorer rolling over in a single vehicle highway tire-related incident are 4.35 while the odds of comparable SUVs rolling over in the same accidents are 1.92.[42] The odds ratio of a fatality occurring in such an accident is nearly three times greater with the Explorer. The Explorer did not fair much better in Texas. In such incidents based on the Texas database, the odds ratio of an Explorer rolling over is 1.58 times

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42 See attached chart.

that of comparable SUVs.[43] The odds ratio of being killed if an individual is in such incident in Texas while in an Explorer is nearly four times that of other comparable SUVs.[44] This data proves that the Explorer in single vehicle, tire related highway incidents simply does not perform up to par with its competitors. The testing performed by Dr. Dennis Guenther show why.

IV. Dr. Dennis A. Guenther's Engineering Analysis Of The Ford Explorer

A. Summary

This analysis is focused on the loss of control experienced by the Explorer in normal highway driving following a rear tire tread/belt separation (hereinafter "tread separation").

Loss of control in this circumstance often results in the Explorer leaving the highway and rolling over or spinning into an angle relative to its path of travel on the roadway sufficient to cause rollover, with or without tripping, or other serious accidents. Because loss of control is a precursor to rollovers and other serious accidents, the hypothesis is suggested by common Explorer accident scenarios that the Explorer has a control problem leading to rollover and other crashes in the event of tread separation.

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43 See id.

44 See attached chart.

Dr. Guenther has tested that hypothesis and found that:

- the Explorer models he has tested, as designed, have a significantly lower amount of understeer than the other SUVs he has evaluated, less than half as much as the Jeep Cherokee and Chevrolet Blazer;
- the Explorer loses much of its small margin of understeer when it is loaded to gross vehicle weight rating; the Cherokee and the Blazer do not;
- the Explorer models tested, unlike the Cherokee and the Blazer, lose all of their understeer and become oversteer vehicles in most circumstances following tread separation on a left rear tire,[45] the predominant tire position in Explorer tread separation crashes; the only exception in Dr. Guenther's investigation is a light load configuration in a counter-clockwise turn, with the separated tire mounted on the left rear, a circumstance where the vehicle retains a very small amount of understeer;
- an oversteer vehicle is extremely difficult for most ordinary drivers to control, particularly at interstate highway speeds where it can become directionally unstable;

His conclusion based on these findings is that the Explorer is defectively designed in that it has an inadequate margin of control in the foreseeable circumstance of tread separation during normal highway driving in most load and turning circumstances.

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45 Left rear tread separation is the most common finding in Explorer accidents involving tread separation and is the condition examined to date.

B. Relevant Engineering / Accident Reconstruction Concepts

1. Understeer/Oversteer

The terms "understeer" and "oversteer", while not particularly descriptive in themselves, are engineering terms that are used to characterize what is one of the most significant control relationships in driving an automobile in the linear range[46] – the amount of steering input necessary to produce an amount of G's of lateral acceleration, which produces the side force that accomplishes turning of an automobile. It is measured and expressed in degrees of steering wheel input per G of lateral acceleration.

The amount of understeer or oversteer in a vehicle is measured by driving the vehicle in a constant radius circle at an increasing speed and recording the degrees of steer input per G of lateral acceleration. In an understeer vehicle a test driver, in terms of what he perceives and does in that circumstance, must steer toward the center of the circle, with increasing steer input as he increases speed, in order to stay on the path of the constant radius circle; that is the same thing the average driver experiences as he drives around a curve – he must steer to the inside of the curve in order to generate the side force necessary to turn the vehicle and stay on the curving path, and the rear of the vehicle follows the front around the circle.

An oversteer vehicle behaves just the opposite. The test driver would have to steer away from the center of the circle in order to stay on the constant radius circle as his speed increases– he would have to "take steer out" or "reverse steer" in order to keep the car on the path of the

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[46] Linear range in this context refers to normal everyday driving by average drivers.

circle as he increases speed.[47] "Because of this need for steering reversal, final oversteer is generally considered bad."[48]

Automobile manufacturers do not intentionally design an oversteer characteristic into cars intended for ordinary drivers because "a vehicle that oversteers, by design or circumstance, is highly undesirable."[49] The vehicle dynamics literature is clear that an oversteering vehicle is directionally unstable – generally speaking, "an understeering vehicle is a directionally stable vehicle" and "an oversteering vehicle is directionally an unstable vehicle."[50] A vehicle is directionally unstable if steering or disturbances, such as wind, generate forces that cause an ever-increasing vehicle response until it spins out.[51] Oversteer characteristically results in spinout.[52]

Generally, it is "desirable to have understeer to avoid directional instability."[53] Ford, like any other automobile manufacturer, tries to build understeer into its cars.[54] They do this because understeer is essential to safely control an automobile.

Car designers can increase or decrease the amount of understeer in a vehicle by many different means – by adjusting spring rates, suspension geometry, frame stiffness, roll damping,

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47 See Gillespie, "Fundamentals of Vehicle Dynamics," for a technical definition of "understeer" and "oversteer."

48 Dixon, "Limit Steady State Vehicle Handling," at page 283, col. 1.

49 Dickerson, et al., "Vehicle Handling with Tire Tread Separation," at 2 (1999).

50 Bergman, "The Basic Nature of Vehicle Understeer-Oversteer" at page 11, col. 1 (1965).

51 Id.

52 See "NHTSA: An Experimental Examination of Selected Maneuvers That May Induce On-Road Untripped, Light Vehicle Rollover – Phase II of NHTSA's 1997-1998 Vehicle Rollover Research Program" at page 29 (1999).

53 Allen, et al., "Characteristics Influencing Ground Vehicle Lateral/Directional Dynamic Stability" at page 27, col. 1 (1991).

54 See, e.g., note 1.

tire properties, tire pressure, weight distribution, and other vehicle and component characteristics. They adjust these and other elements which result in the amount and character of control available. Automobile designers, of course, may adjust these elements for reasons other than achieving or influencing controllability; they may, for example, make such adjustments to seek ride comfort, to achieve a "flat" European cornering feel, to improve rollover resistance, or for other reasons. Each of those trade-offs for such reasons, however, potentially affects the amount of understeer and the amount of control safety margin, and the result is exacerbated by the potentially greater understeer needs of SUVs.

Cars differ from each other in how much control margin, or understeer, they have. How much understeer is necessary to provide a safe margin of control? The answer from an engineering perspective is: The amount necessary to provide predictable vehicle control in foreseeable driving circumstances for the drivers intended for that vehicle.

The foreseeable circumstances of driving include many things – the coefficient of friction of the roadway surface, wind gusts, ice and snow, vehicle load, component wear and failure, the effect of heat and use on the fit and flexibility of suspension system components, and many others. One foreseeable circumstance, of course, is tires wearing out and eventually failing, including tread separation, the most common mode of wearout failure for steel belted radial tires. All of these circumstances can cause an increase in the need for understeer or directly decrease the amount of understeer available in the vehicle. For example, tread separation will change tire properties related to understeer, decreasing cornering stiffness and traction provided by belt and tread.

These are not new considerations for Ford automobile designers. For more than 30 years, the technical literature relating to tire influence on vehicle dynamics has pointed out that in order to avoid oversteer following rear tire failure, "it is desirable to make the car strongly understeer in the original condition."[55] Tests on the predecessor to the Explorer, the Bronco II, demonstrated that following rear tire tread separation that "vehicle exhibited dramatic oversteer characteristics and was unstable."[56]

Not only is oversteer an unacceptable vehicle characteristic, but the transition from understeer to oversteer that might occur in the event of loss of tread and tire cornering properties, if sufficient understeer is not originally built into the car, is particularly dangerous. The unexpected reversal of the handling characteristics of the car in that circumstance is just the sort of unexpected event that leads to driving accidents; it is particularly unexpected because "none of the currently manufactured passenger cars show such behavior in ordinary driving."[57] The ordinary driver has not experienced and cannot anticipate the catastrophic results of this reversal

One of the car designer's engineering obligations is to quantify the amount of understeer and other vehicle control characteristics required to account and compensate for such varying and foreseeable events, the inevitable changes in driving circumstances. By that quantification he determines the amount of understeer, the margin of control, that must be designed into the car.

2. Tread Separation

Tread separation is a failure mode usual in steel belted radial tires.[58] The majority of Firestone tires incurring a tread separation, without some causally related damage to the tire, are

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55 Kondo, et al., "Dynamical Behaviors Of A Car When One Tire Is Punctured Simulatively" at pages 2, 43 (1968).

56 See note 49.

57 Bergman, "Considerations in Determining Vehicle Handling Requirements" at page 7, col. 1 (1969).

58 See, e.g. Robinette, et al., "Drag and Steering Effects of Under Inflated and Deflated Tires" (1997).

high mileage tires with long use. The causes of this form of failure are heat, loading, oxidation and cyclic stressing, all of which can weaken and result in shearing of the rubber bond between the layers of steel belts, which centrifugal force can then pull apart. This breakdown is an inevitable result of the chemical and physical properties of rubber tires and how they are commonly used.

Those who are unfamiliar with tires or with accident reconstruction tend to describe tread separations or accidents associated with tread separations as if they are explosive events in which the vehicle is thrown out of control by the force of the separation. The scientific literature and testing commissioned by automobile manufacturers and others, however, has repeatedly demonstrated that this is not correct.

For example, Carr Engineering, vehicle dynamics experts regularly retained by Ford to testify in automotive litigation, carried out testing on behalf of Ford relating to, among other things, the forces involved in tread separation. Their findings in those tests led them to conclude:

> During the tread separation event, the tire did pull the vehicle slightly to one side but the driver kept a straight line path with a small steering correction. This amplitude of steer angle is small and on the order required to keep a vehicle in the lane on curved highways or in a straight path during other events such as wind gusts or driving through water puddles at highway speeds.[59]

Other automotive researchers, including plaintiff experts pursuing forensic inquiries, academic researchers, and Firestone, have arrived at the same conclusion based on numerous tests, including tests involving the Explorer and the Firestone tires mounted on it as original equipment. For example:

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59 Document BGC 0016305-311, memorandum from Tandy to Mickus, January 23, 1999, at pages 2-3.. [Test vehicles included a 1993 Ford Explorer, 1986 Ford Bronco II, 1986 Ford Bronco II (continued...)

- "[S]eparation by itself was not sufficient to cause loss of control."

  "No induced steering was felt as a result of tread separation." "Test results by this author corroborate work by Gardner who measured that steering wheel inputs during tread separation are of the order of magnitude of lane change maneuvers during high speed travel."[60]

- "Maintaining control of the vehicle after tread/belt separation requires a steering torque similar to that required for a lane change maneuver." "The results of the testing show that the forces developed during a tread/belt detachment are well within the range of a driver's ability to control a vehicle."[61]

- "Little or no corrective steering action was needed to maintain control of the vehicle during the tread separation events."[62]

Descriptions of tread separation related accidents also sometimes fail to accurately capture the sequential nature of those accidents. Engineering analysis and accident reconstruction require that tread separation and accidents associated with them be broken down into their separate parts. For those purposes, the accident events should be viewed as three separate and sequential elements:

(...continued)

XLT, 1994 Dodge Intrepid, 1987 Ford Club Wagon van, 1990 Ford Bronco, 1990 Ford Aerostar van, 1987 Toyota van].

60 Klein, et al. "Anatomy of Accidents Following Tire Disablements," at page 6 (1999). [Test vehicles were 1989 Pathfinder and 1982 Chevrolet pickup].

61 Gardner, "The Role of Tread/Belt Detachment In Accident Causation," at pages 7-8, 10 (1998). [Test vehicles were Ford Explorer, Camry Station Wagon, and Chevy Truck C2500].

62 Fay, et al., "Drag and Steering Effect from Tire Tread Belt Separation and Loss," at page 13 (1999). [Test vehicle was 1993 Ford Taurus].

a. Pre-separation

This is characterized by vibration felt generally in the vehicle, (see notes 58 and 60) as the tire is deformed from a smooth circle to an irregular "circle" by movement of the tread and belt. This vibration is something most drivers have experienced in connection with a failed tire, whether a puncture blowout or a tread separation or some other mode of tire failure.

The vibration serves as notice that something is wrong with a tire, a message that most drivers understand as requiring them to take their foot off the gas, check the traffic around them, and begin to move to the shoulder of the highway to change the tire.

b. Separation

Testing, (see notes 58,59,60 & 61) establishes that the actual tread separation is a benign event in terms of the amount and duration of forces exerted on the automobile laterally, longitudinally and vertically.

c. Post-separation

In the period immediately following tread separation on a rear tire any SUV will lose some understeer because the tire properties contributing to control of the vehicle – cornering stiffness, traction, etc. – will have been reduced because of removal of the tread and one of the steel belts. It is the controllability of the Explorer in this circumstance that Dr. Guenther is investigating.

C. Engineering Evaluation Of Explorer Directional Control

Dr. Guenther was retained by counsel to assist them in the preparation of Firestone's defense in the personal injury litigation arising out of Explorer crash and rollover accidents. While he made measurements of and inspected various Explorers and engaged in some accident reconstruction at the direction of counsel, he did not undertake the dynamics testing and data analysis underlying his conclusions concerning the controllability of the Explorer until last month.

Firestone had expected that Ford, as part of a root cause analysis, would focus on the vehicle and provide Firestone, NHTSA and the Congress information about the vehicle's handling in a tread separation event. Ford has 15 years of experience in the design and development of and litigation about the Explorer. They have that information. Firestone requested Ford participation in investigation of the vehicle in October of last year. In spite of repeated follow up requests, Ford made no response to Firestone. It became clear that Dr. Guenther's engineering evaluation of the Explorer would be important not only in defense of the litigation but in addressing congressional, regulatory and public concerns about automotive safety relating to loss of control and rollover of the Explorer when it experienced tread separation.

1. Testing Conducted

a. Site

The tests were carried out at the Transportation Research Center, Inc. (TRC) test facility near East Liberty, Ohio. The facility is used on a contract basis by numerous automobile manufacturers, component suppliers, and state and national regulatory authorities to conduct automotive safety testing. It was used by NHTSA, for example, in 1997-98 to conduct extensive tests of maneuvers that may induce on-road untripped rollover in various vehicles, including the Ford Explorer.[63] Ford used TRC in development testing of the UN-105, the version of the Explorer offered in 1995 and subsequent years.

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[63] See note 52.

b. Study Objectives

The purpose of the testing program, which is ongoing, is to examine the margin of control in the Explorer as designed and, comparatively, in peer SUVs in the circumstance following rear tire tread separation. Due to the complexities and non-linearity of vehicles and the nature of the Explorer accidents, Dr. Guenther chose to explore the linear range as a preliminary investigation. In the linear range, a principal parameter of control is the understeer/oversteer gradient (other parameters such as steering response time and gain, and steering frequency response are also being examined as they may relate to loss of control in the event of tire tread separation).

c. Test Vehicles

The vehicles evaluated are the following:

1996	Ford Explorer	4 dr	4 x 2
1996	Chevy Blazer	4 dr	4 x 2
2001	Jeep Cherokee	4 dr	4 x 2
2000	Ford Explorer	4 dr	4 x 2

Each vehicle was tested with its original equipment (OE) tires at OEM recommended tire pressure. The 1996 Explorer was tested with both OE Firestone tires and OE Goodyear tires recommended by Ford.

d. Vehicle Instrumentation and Measurement

The data acquired for purposes of this analysis was the following:[64]

<u>Vehicle Input</u>

Steering Wheel Angle

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64 See attached exhibit 5.

Vehicle Speed

Vehicle Response

Lateral Acceleration

Yaw Rate

Body Roll Angle

e. Test Maneuvers

The tests conducted are universally recognized standard tests used by automobile manufacturers, including Ford, and other researchers in vehicle dynamics for establishing the values investigated. The tests are as follows:

Step Steer - The vehicle is driven on the test pad area in a straight line at a constant speed. The driver then rapidly turns the steering wheel until it hits a mechanical stop. Steering wheel stops are set to attain a desired lateral acceleration at the test speeds. This steer angle is held until steady-state response is established.

Tests were run in both directions (right turn/left turn) and at two speeds (60 mph and 40 mph). The test was run both with four good tires and with the left rear tire detreaded by cutting between the steel belts; test runs with the detreaded tire were done only at the slower 40 mph speed. Test runs were done at both light load (curb plus driver and instrumentation) and heavy load (gross vehicle weight rating).

The test is used to measure vehicle response times as related to lateral acceleration and yaw velocity response, and to measure the gain of these responses in relation to steering wheel input (output divided by input).

Constant Radius Circle - The vehicle is driven around a 200 foot constant radius circle with increasing speed. The driver adjusts the steering angle (by turning the steering wheel) as necessary to keep the vehicle on the path of the circle.

Test runs were done in both directions, clockwise and counter-clockwise, with four good tires and with the left rear tire detreaded. Test runs were done at light load (curb plus driver and instrumentation) and heavy load (gross vehicle weight rating).

The test is used to measure understeer and oversteer (degrees of road wheel steer per Gs of lateral acceleration).

Frequency Response - Sinusoidal sweep steering tests are frequently used to determine the linear response of vehicles. The vehicles in these tests were driven on a long straightaway with the driver steering with slowly increasing frequency up to approximately 3 to 4 hz followed by decreasing frequency. The test was run at a nominal speed of 66 mph.

The test measures lateral acceleration gain, yaw velocity gain, and phase angles at the frequencies tested (up to 3 to 4 hz).

f. Results of Directional Control Tests

The results of the constant radius circle tests are set forth in data sheets and charts attached hereto as Exhibit 6. Data reduction and analysis continues with respect to the step steer and frequency response tests.

In summary, the findings in the tests are as follows:

Constant Radius Circle – This standard method of measuring understeer/oversteer gradient establishes that the Explorer, with four good tires, has a relatively small amount of understeer compared to other SUVs tested – less than half the amount found in the Blazer and the Cherokee. In fact, the Cherokee has about the same understeer with a detreaded tire as the

Explorer with four good tires. These findings are consistent with NHTSA vehicle characterization tests that found that the Explorer had the lowest amount of understeer of the 12 vehicles on which it conducted rollover-inducing maneuver tests.[65]

The test results show that, unlike the other SUVs tested, the Explorer loses its small margin of understeer when it experiences a tread separation and becomes an oversteer vehicle.

This is true whether the Explorer is operated on Goodyear OE tires recommended by Ford or on Firestone OE tires.

The Explorer's oversteer characteristic is worse in the loaded condition. The only circumstance in which it does not become oversteer with a detreaded tire is when it is lightly loaded (curb plus driver and instrumentation) and the detreaded tire is on the inside rear position (left rear in a counter-clockwise turn); in test runs in that configuration the Explorer is almost neutral steer with respect to the understeer/oversteer gradient.

An oversteer vehicle is not safe at highway speeds in the hands of an average driver. Sometimes a driver may achieve directional control, sometimes he may not.

In addition to his dynamic testing, Dr. Guenther has carried out several accident reconstructions involving Explorer crashes and reviewed numerous police accident reports concerning such accidents. Explorer rollover accidents, as reflected in those reconstructions and police accident reports, frequently occur

- on interstate or similar high-quality, high-speed roadways, without environmental interference;
- in straight line travel;

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65 See note 42.

- at highway speed
- with no driver impairment
- with no risky behavior
- with rear tire tread separation
- with some apparent effort at driver steering control reflected in change(s) of vehicle heading and path of travel.

2. Conclusion

The Explorer is an oversteer vehicle in most circumstances after it experiences tread separation. Oversteer can make a vehicle directionally unstable and subject to loss of control in the hands of most drivers. This is a vehicle problem, not a tire problem. The vehicle performs the same following tread separation on the Goodyear tire as it does the Firestone tire. This must be regarded as a highway safety defect within the meaning of the National Traffic and Motor Vehicle Safety Act.

V. The Ford "Explorer Vehicle Dynamics Presentation" To NHTSA Of March 28-29, 2001 Concerning Explorer Loss Of Control Following Tread Separation Is Misleading And Irrelevant

The following statements and charts are examples of the many inaccuracies and irrelevancies contained in the Ford vehicle dynamics presentation to NHTSA:

- Statement at page TH-3 18. Exhibit 7 – The statement about tread separation, "This fundamental cause [of loss of control, i.e., decreased tire traction] overwhelms differences in design among vehicle classes or within vehicle classes. Explorers perform like all other vehicles", is true only with respect to limit maneuvers, that is, at high lateral acceleration where most of us never operate a vehicle, even in most emergency maneuvers. The statement is not relevant or accurate in the linear range of maneuvering, that is, at low lateral accelerations experienced in normal driving (e.g., 0.3 Gs or less). The maneuver involved in correcting for the small amount of drag following a belt separation (similar to a normal lane change steer, according to SAE test literature),[66] or the maneuver involved in bringing the car to the shoulder so that you can change the tire is just such a low lateral acceleration maneuver, even at highway speeds.

In normal everyday driving maneuvers following a tread separation the Explorer does not perform like all other vehicles. In this circumstance, it has a higher likelihood of loss of control because it lacks the necessary margin of understeer to remain directionally controllable in highway maneuvers involved in normal driving. Peer SUVs, such as the Cherokee and Blazer, remain understeer and more controllable in a wider range of maneuvers following tread separation than the Explorer.

- Statement at page TH-3 76. Exhibit 7 – This chart purports to show results of various SUV vehicles in a constant radius circle test following a tread separation. It shows all vehicles including the Explorer maneuvering at more than 0.5 G lateral acceleration with a separated tire on the outside rear. That is a physical impossibility in normal highway travel; these vehicles in general and the Explorer in particular cannot generate that much lateral acceleration with a detreaded tire in the outside rear position in normal highway travel. The Explorer will spin out of control before it reaches 0.5 G lateral acceleration in this circumstance. Ford can do it only as a trick on a low speed 100 foot radius circle. It indicates the irrelevant nature of the information presented to NHTSA in its vehicle dynamics presentation.

The suggestion accompanying the chart that "Explorers and peer vehicles oversteer above approximately 0.4G, with tread off of outside rear tire" is not accurate or relevant. The Explorer

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66 See, e.g., Klein, et al., "Anatomy of Accidents Following Tire Disablements" (1999).

with a detreaded tire is oversteer in that circumstance at all lower lateral acceleration levels while the Blazer and Cherokee are not. Moreover, it is not relevant to an analysis of highway safety in normal driving because motorists generally do not operate their vehicles at the higher level of lateral acceleration examined by Ford. The assertion is made that "tread separation on O/S rear tire narrows differences among all vehicles (overwhelms design differences)" is, again, not accurate in the linear range; it only applies to limit maneuvers. Following tread separation, the Blazer and Cherokee maintain understeer in the linear range while the Explorer has none and changes completely to oversteer; the Cherokee, in fact, has about as much understeer with a detreaded outside rear tire as the Explorer does with four good tires. Similarly, the statement that "Explorer performance is typical of peer vehicles" is not accurate for linear range operations for the same reason. The Explorer is oversteer in the linear range of lateral acceleration following outside rear tread separation (about 0.3G or less); other SUVs remain understeer in the linear range.

- Statement at page TH-3 87. Exhibit 7 – This simulation chart depicts all vehicles as having the same maneuvering limits following a tread separation. Dr. Guenther's testing at TRC demonstrates the contrary in the linear range and the computer-generated simulation has no basis in fact.

- Statement at page TH-3 132. Exhibit 7 – The first and fourth statements on this page are presented without any supporting data of any sort. The Explorer does not "perform similar to others in its class in the event of a tire tread separation", rather, it becomes oversteer, an unpredictable, unfamiliar, unsafe handling condition. For that reason, the Explorer does not "have a margin of safety 'as designed' to accommodate, to a reasonable level, component failures including tread separations."

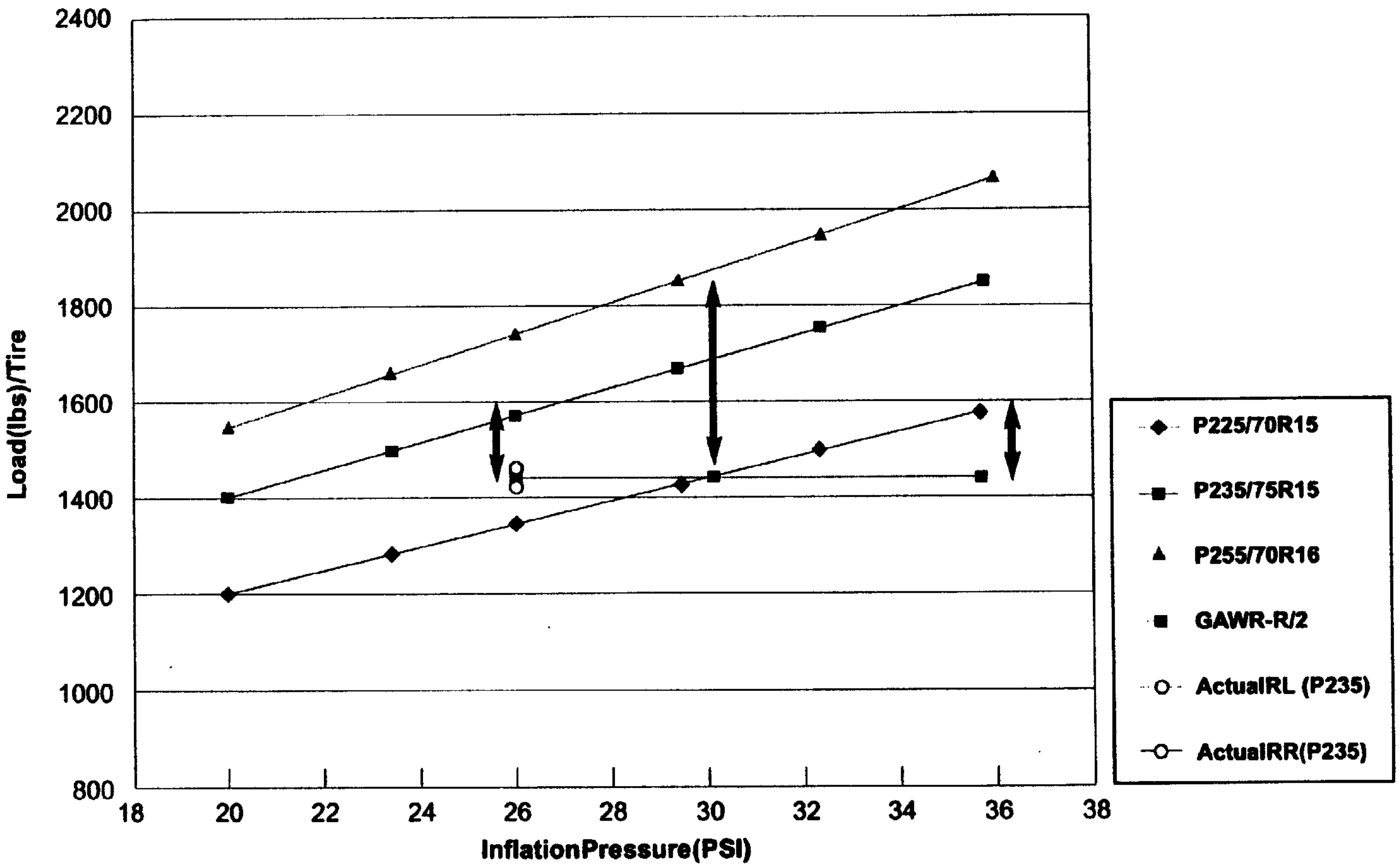
- Statement at page TH-3 134. Exhibit 7 – The fourth statement on this page is false. The designers of the Blazer and the Cherokee have in fact provided a margin of control safety following tread separation in the design of those vehicles. They did it more than a decade ago, when the Blazer and the Cherokee were the primary SUV examples available to Ford engineers for comparative analysis when they designed and developed the Explorer.

VI. Conclusion

Ford has had over twenty years to adjust the design of the Ford Explorer and to work cooperatively and responsibly with its tire suppliers to ensure the safety and stability of its vehicle. To date, it has failed to do so. The design of the Explorer is an oversteer vehicle in the event of a tread separation. A tread separation is normally a benign event that a driver can control by pulling to the shoulder of any roadway. The flawed design of the Explorer, however, renders the vehicle in a tread separation event susceptible to rollover and therefore potentially lethal. While real world data and an engineering analysis of the vehicle confirm this phenomenon, Ford refuses to accept the facts and take responsibility. The purpose of this analysis is to ensure that these facts are publicly known, and, in the best case, to compel Ford to take responsibility for its flawed attempts to protect its defective product.

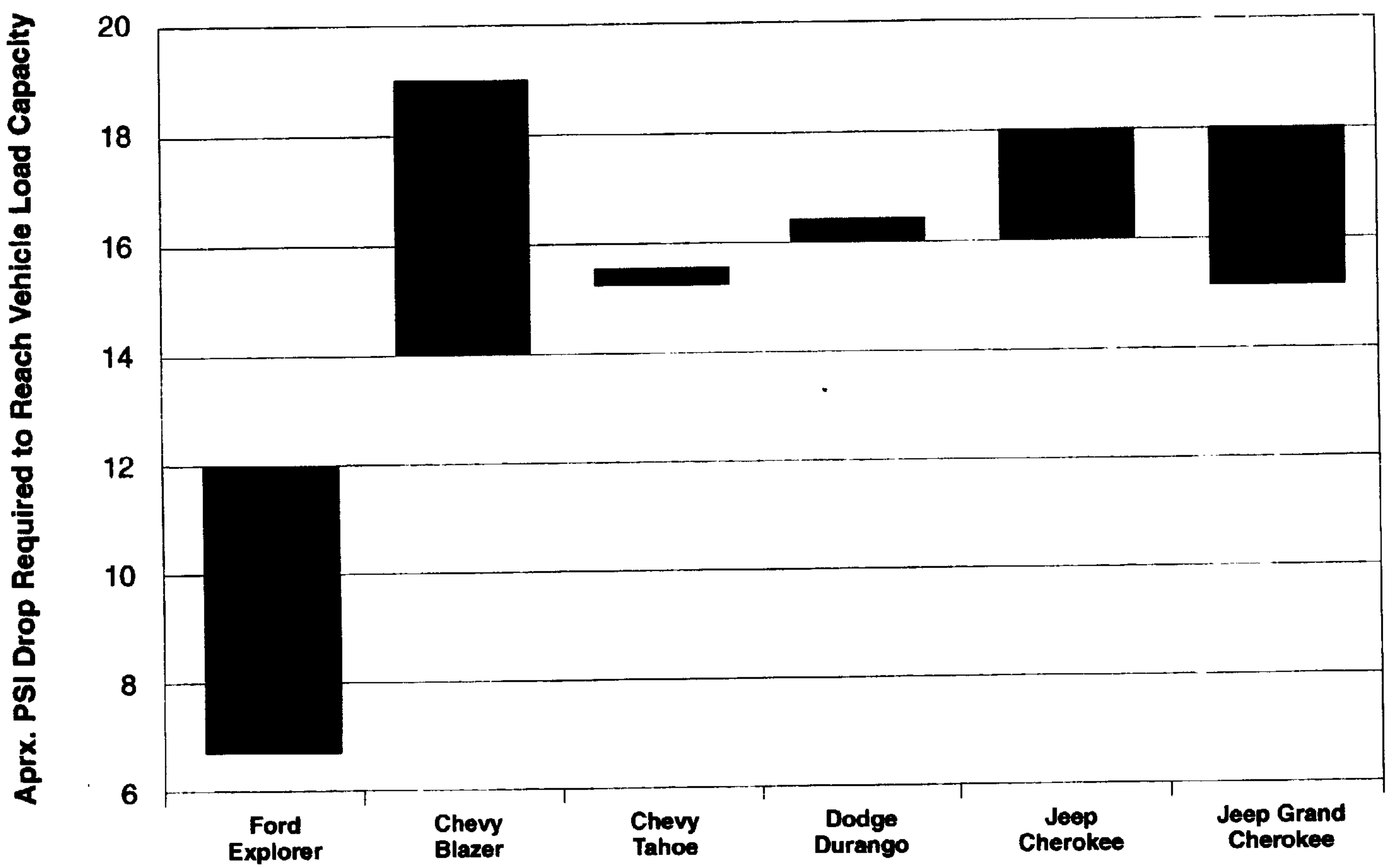
Attachment 1

TireLoadCapacity-Explorer
98XLT/FortStocktonMeasurement



Attachment 2

Tire Inflation Safety Factor per SUV (I)

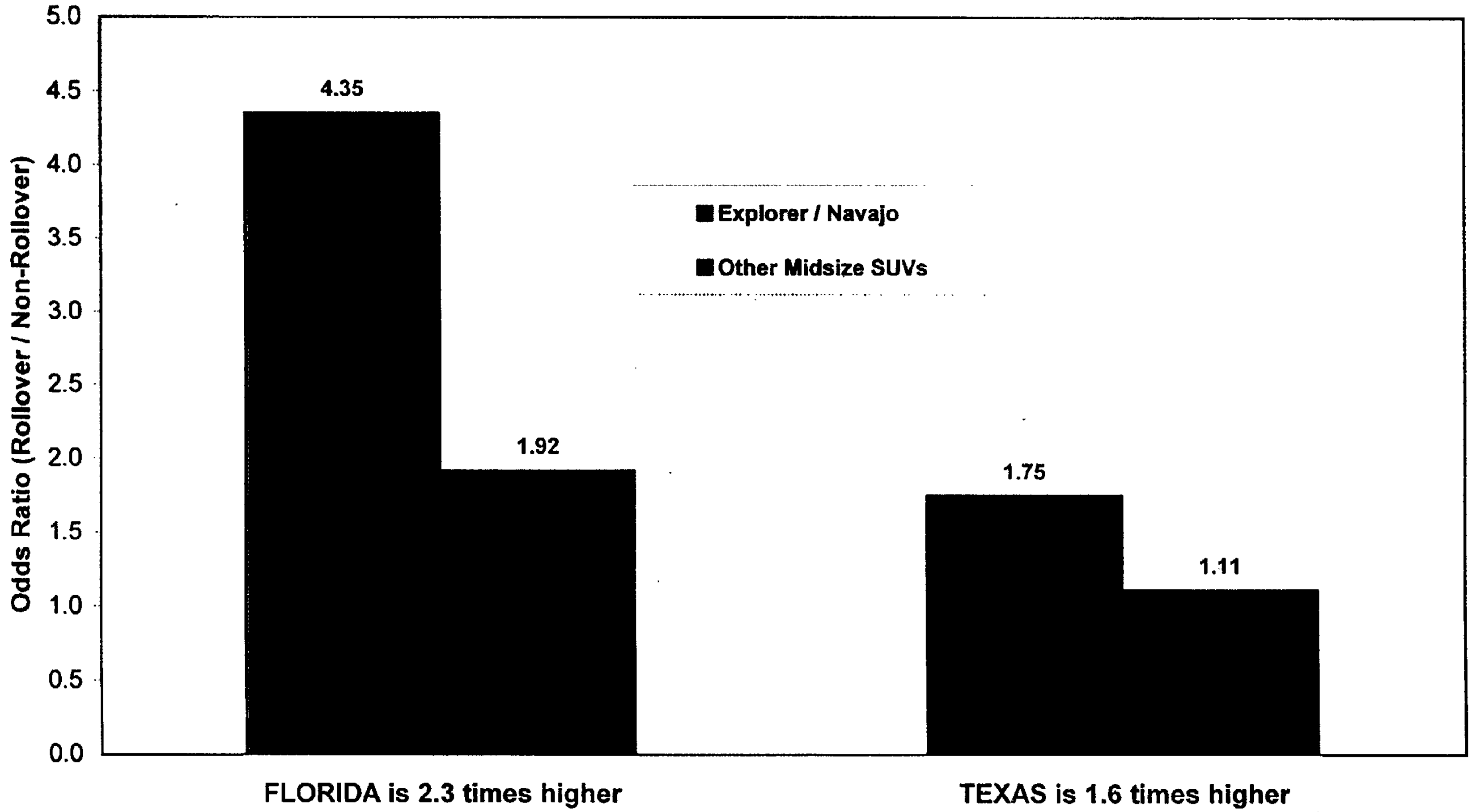


Ford Explorer has low safety margin versus other popular SUVs.

• Bar height based upon range of vehicle GVWs.

Attachment 3

The Odds of a Ford Explorer / Mazda Navajo Having a Rollover in a Tire-Related Single Vehicle Highway Accident is Higher than Other Midsize SUVs.



FLORIDA CRASH DATABASE ANALYSIS

DOCUMENTATION FOR MID-SIZE SUV COMPARISON

JUNE 11, 2001

FLORIDA DATABASE OVERVIEW

The analyses in this document are based on the Florida Traffic Crash Database. The Florida Traffic Crash Database contains information on motor vehicle crashes that occurred in the state of Florida in calendar years 1993-1999, and through the first three quarters of 2000.[1] It is organized in seven relational databases containing information on the Event, Vehicle, Driver, Pedestrians, Violations, Passengers and D.O.T Site Location.

Only crashes that required police intervention or the provision of emergency services are present in the database, since official reports are only produced if these agencies are involved in the incident. All statistics presented refer only to the population of vehicles involved in the reported incidents, i.e. all statistics are conditional on being in the crash database.

To identify the specific vehicle make and model, a VIN decoder was used. The analyses presented here are based on VIN decoding of the database by Firestone. Firestone utilizes a POLK VIN decoder, a commercially available VIN decoder.

Of the 2,894,366 records in the Florida database that are vehicle type automobile, passenger van, or pickup/light truck (2 rear tires) [Type of Vehicle = 01, 02, or 03], 2,783,084 had 11-digit VIN numbers and were sent to be VIN decoded. Of these 2,783,084 records, 2.1 million records (2,088,901 specifically) were VIN decoded. Of the 111,282 that did not have 11-digit VINs, 20,299 records had between 7 and 10 digits. A minimum of 7 digits is required to identify make and model. Make and model cannot be identified for the other 90,983.

Among the 2,088,901 VIN decoded records, 177,705 are single vehicle crashes. Of these, 19,226 are sport utility vehicle (SUV) crashes and 10,989 are mid size sport utility crashes. Of the 10,989 mid-size SUV crashes on any road, 2,491 are single vehicle mid-size SUV highway crashes. Of these, 202 are tire-related (about 8 percent) and 2,289 (about 92 percent) are non-tire related single vehicle highway crashes.

The information contained in this document has not yet been presented to congress.

VEHICLE POPULATION FOR ANALYSIS

- SUV single vehicle highway crashes from 1993-2000 (accident years 1993-2000 and all model years).
- SUVs were identified based on three external lists identifying SUVs: (1) J.D. Powers (JDPA) customer satisfaction surveys from the following years: 1999, 1997, 1996, and 1995; (2) NHTSA's list of SUVs Crash-Tested by NHTSA Model Years 1990-2001, and (3) all SUVs identified in the 2001 Official JDPA Vehicle Segmentation Guide list including the following segments: Entry SUV Segment, Midsize SUV segment, Full Size

[1] The latest Crash Date in the database is August 7, 2000.

LAMPE_J-00085

SUV Segment, and Luxury SUV segment. The complete list of SUVs and the specific SUVs identified in the Florida database are included in Appendix A to this document.

- From the complete SUV list, mid-size SUVs were identified based on two criteria. First, we included vehicles with weights similar to the Ford Explorer. Second, we included all vehicles identified as midsize in the JDPA market segment list (the Ford Explorer is identified as mid size) unless the weight was more similar to the Ford Expedition than to the Ford Explorer. The Explorer weight range is approximately 4600-5600 pounds whereas the Expedition weight range is approximately 6,800 to 7200 pounds.

VARIABLE DEFINITIONS

- Type of Vehicle – type of vehicle is automobile, passenger van, or pickup/light truck [2 rear tires] (Type of Vehicle = 01, 02, or 03).
- Single Vehicle – number of vehicles involved in the crash is equal to 1 (Total Number of Vehicles).
- Highway – Crash occurred on an Interstate, US Highway, Turnpike/Toll (Road System Identifier = 01, 02, or 06)
- Vehicle Identification Number –11-digit VIN used to identify information about a specific vehicle (e.g., make and model) after decoding.
- Vehicle Make – Digits 1, 2, and 3 from the VIN number identify vehicle manufacturer, make, and type (e.g., Ford Motor Company, Ford, passenger car).
- Vehicle Model – Digits 5, 6, and 7 from the VIN number identify vehicle line and body type (e.g., Taurus GL 4-door sedan).
- Explorer and Navajo – For the Explorer, make is Ford and model is Explorer (all types including XL, XLS, etc.). For the Navajo, make is Mazda and model is Navajo.
- Mid Size SUVs – all SUV makes and models identified in Appendix A for Florida except the Ford Explorer and the Mazda Navajo.
- Tire-related Incident – A tire-related incident is defined as tire puncture/blowout or worn/smooth tires (1^{st} Vehicle Defect = 03 (worn/smooth tires) or 05 (puncture/blowout) OR 2^{nd} Vehicle Defect = 03 or 05).
- Rollover – The first harmful event that took place in the crash is identified as overturned (1^{st} Harmful Event = 31).
- Fatality Incident - The crash injury severity is identified as fatal injury (Crash Injury Severity = 5) or the injury severity of the driver is identified as fatal injury (Injury Severity (Driver) = 5).

The pages from the Florida Traffic Crash Database Directory that describe the variables listed above are provided in Appendix B to this document.

RESULTS

Table 1 shows the rollover comparison between the Ford Explorer/Navajo and other mid-size SUVs for single vehicle highway tire-related incidents in Florida (202 incidents). The likelihood of a rollover for:

- The Ford Explorer/Mazda Navajo is 81%.
- Other mid-size SUVs is 66%.

The likelihood ratio is 1.236 and the 90% confidence bounds (which shows a 5% test on each side) are 1.075 to 1.422. This ratio is significantly different than 1.0. If both vehicles were the same in regards to the tire-related rollover probability, we would expect the ratio to be 1.0. Hence, we conclude that the vehicles are different.

The odds of a rollover for:

- The Ford Explorer/Mazda Navajo is 4.35.
- Other mid-size SUVs is 1.92.

The ratio of the odds is 2.27.

TABLE 1. SINGLE VEHICLE HIGHWAY TIRE RELATED ACCIDENTS IN FLORIDA - ROLLOVER: 1993-2000

Vehicle Type	Tire Related Single Vehicle Highway Accidents in Florida		
	Rollover	No Rollover	Total
Explorers and Navajos	74 (81.32)	17 (18.68)	91 (45.05)
Other mid-size SUVs	73 (65.77)	38 (34.23)	111 (54.95)
Total	147	55	202

Table 2 shows the fatality incident comparison between the Ford Explorer/Navajo and other mid-size SUVs for single vehicle highway tire-related incidents in Florida (202 incidents). The likelihood of a fatality incident for:

- The Ford Explorer/Mazda Navajo is 17%.
- Other mid-size SUVs is 6%.

The likelihood ratio is 2.614 and the 90% confidence bounds (which shows a 5% test on each side) are 1.277 to 5.349. <u>This ratio is significantly different than 1.0. If both vehicles were the same in regards to the tire-related fatality incident probability, we would expect the ratio to be 1.0. Hence, we conclude that the vehicles are different.</u>

The odds of a fatal incident for:

- The Ford Explorer/Mazda Navajo is 0.197.
- Other mid-size SUVs is 0.067.

The ratio of the odds is 2.94.

TABLE 2. SINGLE VEHICLE HIGHWAY TIRE RELATED ACCIDENTS IN FLORIDA – FATALITY INCIDENTS: 1993-2000

Vehicle Type	Tire Related Single Vehicle Highway Accidents in Florida		
	Fatality Incident	Non Fatality Incident	Total
Explorers and Navajos	15 (16.48)	76 (83.52)	91 (45.05)
Other mid-size SUVs	7 (6.31)	104 (93.69)	111 (54.95)
Total	22	180	202

APPENDIX A

SUV REFERENCE LIST AND MID-SIZE SUVS IDENTIFIED IN FLORIDA CRASH DATABASE (MIDSIZE LIST = 1)

THE Mid-Size SUV LIST

Make	Model	X if SUV is in Florida Crash database	X if SUV is in Texas Crash database	JD Power Market Segment	Gross Weight (Min)	Gross Weight (Max)	Midsize List
AM General	Hummer H3			Midsize	NA	NA	
Buick	Rendezvous			Midsize	NA	NA	
Chevrolet	Blazer	X	X	Midsize	4450	5300	1
Chevrolet	S-10 Blazer	X	X	Midsize	4350	5100	1
Chevrolet	Trailblazer			Midsize	NA	NA	
Chrysler	Citadel			Midsize	NA	NA	
Dodge	Durango	X		Midsize	6050	6400	
Ford	CrossTrainer Wagon			Midsize	NA	NA	
Ford	Explorer	X	X	Midsize	4760	5560	1
Ford	Ranger SUV			Midsize	4420	5120	1
GMC	Envoy			Midsize	NA	NA	
GMC	Jimmy	X	X	Midsize	4450	5300	1
GMC	Jimmy Sonoma	X	X	Midsize	4450	5300	1
GMC	Jimmy/Envoy	X		Midsize	4450	5300	1
Honda	MAV			Midsize	NA	NA	
Honda	Passport	X	X	Midsize	3958	3958	1
Isuzu	Axiom			Midsize	3920	4180	1
Isuzu	Rodeo	X	X	Midsize	4550	4900	1
Isuzu	Rodeo/Rodeo Sport	X		Midsize	4550	4700	1
Isuzu	Trooper	X	X	Midsize	5350	5550	1
Isuzu	Trooper II	X	X	Midsize	5510	5510	1
Isuzu	VehiCROSS	X		Midsize	4852	4852	1
Jeep	Grand Cherokee	X	X	Midsize	4950	5600	1
Land Rover	Discovery	X	X	Midsize	4465	4576	1

Mazda	Navajo	X	X	Midsize	3785	4184	1
Mazda	Nextourer			Midsize	NA	NA	
Mercury	Mountaineer	X	X	Midsize	4780	5560	1
Mitsubishi	Montero	X	X	Midsize	5732	5732	1
Mitsubishi	Montero Sport	X	X	Midsize	4730	5000	1
Nissan	Pathfinder	X	X	Midsize	3980	4075	1
Oldsmobile	Bravada	X	X	Midsize	4049	5300	1
Subaru	Lambda SUV			Midsize	NA	NA	
Toyota	4-Runner	X	X	Midsize	5250	5400	1
Toyota	Highlander			Midsize	4982	4982	1
Volkswagen	SUV			Midsize	NA	NA	
Acura	MDX			Luxury	5690	5690	1
Acura	SLX	X	X	Luxury	4315	4315	1
AM General	Hummer			Luxury	NA	NA	
BMW	X3			Luxury	NA	NA	
BMW	X5	X		Luxury	4795	4795	1
BMW	X7			Luxury	NA	NA	
Cadillac	Crossover			Luxury	NA	NA	
Cadillac	Escalade	X		Luxury	5572	5572	
Cadillac	LAV			Luxury	NA	NA	
Infiniti	Crossover			Luxury	NA	NA	
Infiniti	Fullsize SUV			Luxury	NA	NA	
Infiniti	QX4	X	X	Luxury	4275	4275	1
Land Rover	DiscoverySeriesII	X	X	Luxury	4576	4630	1
Land Rover	Range Rover	X	X	Luxury	4828	4828	1
Lexus	LX 450	X	X	Luxury	4751	4751	1
Lexus	LX 470	X		Luxury	5401	5401	
Lexus	RX300	X		Luxury	3789	3925	
Lincoln	Compact SUV			Luxury	NA	NA	
Lincoln	LAV			Luxury	NA	NA	

Lincoln	Navigator	X		Luxury	6750	7200	
Mercedes Benz	Crossover SUV			Luxury	NA	NA	
Mercedes Benz	M-Class			Luxury	NA	NA	
Mercedes Benz	ML-Class (ML320)	X		Luxury	NA	NA	
Mercedes Benz	MLG			Luxury	NA	NA	
Porsche	Cayenne			Luxury	NA	NA	
Saab	SUV			Luxury	NA	NA	
Toyota	LandCruiser	X	X	Luxury	6470	6860	
Volvo	SUV			Luxury	NA	NA	
AM General	Hummer H2			Fullsize	6964	6964	
Chevrolet	Suburban	X	X	Fullsize	6800	8600	
Chevrolet	Tahoe	X	X	Fullsize	6100	6800	
Ford	Bronco	X	X	Fullsize	6000	6450	
Ford	Excursion	X		Fullsize	8800	9200	
Ford	Expedition	X	X	Fullsize	6700	7200	
GMC	Denali	X		Fullsize	5583	5583	
GMC	Suburban	X	X	Fullsize	6800	8600	
GMC	Typhoon	X		Fullsize	4700	4700	1
GMC	Yukon	X	X	Fullsize	6800	6800	
GMC	Yukon Denali	X	X	Fullsize	6800	6800	
GMC	Yukon XL	X	X	Fullsize	6800	6800	
GMC	Yukon XL Denali	X	X	Fullsize	6800	6800	
Nissan	Fullsize SUV			Fullsize	NA	NA	
Toyota	Sequoia			Fullsize	6500	6600	
Chevrolet	Tracker	X		Entry	3080	3924	
Chevrolet	Traverse			Entry	NA	NA	
Chrysler	Korando			Entry	NA	NA	
Chrysler	Musso			Entry	NA	NA	
Ford	Escape			Entry	4100	4570	1
Geo	Tracker	X	X	Entry	2189	2189	

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Honda	CR-V		X	Entry	3164	3164	
Hyundai	Santa Fe			Entry	4950	5240	
Isuzu	Amigo	X	X	Entry	4100	4500	1
Jeep	Cherokee	X	X	Entry	4550	4900	1
Jeep	Liberty			Entry	NA	NA	
Jeep	Varsity			Entry	NA	NA	
Jeep	Wrangler	X	X	Entry	4300	4450	1
Kia	Sportage	X	X	Entry	4296	5896	1
Land Rover	Defender	X	X	Entry	3600	3600	
Land Rover	Freelander			Entry	NA	NA	
Mazda	Tribute			Entry	NA	NA	
Mitsubishi	Dingo			Entry	NA	NA	
Nissan	Crossover			Entry	NA	NA	
Nissan	Xterra	X		Entry	3504	3858	
Pontiac	Aztek			Entry	NA	NA	
Saturn	VUE			Entry	NA	NA	
Subaru	Forester	X		Entry	3125	3125	
Suzuki	Grand Vitara	X		Entry	3375	3500	
Suzuki	Samurai	X	X	Entry	2870	2932	
Suzuki	Sidekick	X	X	Entry	3086	3682	
Suzuki	Vitara	X		Entry	2875	3375	
Suzuki	X90	X	X	Entry	2734	2954	
Suzuki	XL7			Entry	NA	NA	
Toyota	Rav4	X	X	Entry	3550	3948	

APPENDIX B

FLORIDA DIRECTORY OF DEFINITIONS FOR VARIABLES USED IN ANALYSIS (NOT ATTACHED)

Attachment 4

TEXAS CRASH DATABASE ANALYSIS

DOCUMENTATION FOR MID-SIZE SUV COMPARISON

JUNE 11, 2001

TEXAS DATABASE OVERVIEW

The results presented in this document are calculated using the State Data System-Texas database of crash incidents. This database was obtained by PA Consulting in March, 2001 from NHTSA. The database contains information on motor vehicle crashes that occurred in the state of Texas in calendar years 1989-1999. It is organized in three relational databases containing information on the Crash, Vehicle and Person.

Only crashes that required police intervention or the provision of emergency services are present in the database, since official reports are only produced if these agencies are involved in the incident. All statistics presented refer only to the population of vehicles involved in the reported incidents, i.e. all statistics are conditional on being in the crash database.

The make and model of the vehicle was identified in the Texas crash database so no VIN decoding of this database was necessary to identify vehicle make and model. The make-model field had no missing values.

The Texas database does not include the Ford Explorer in the database until 1994 so this analysis is limited to crashes that occurred between 1994 and 1999 for all model years.

Of the 6.8 million records in the Texas crash database, 3,505,168 crashes occurred in accident years 1994-1999 and 447,394 are single vehicle crashes. Of these, 22,459 are single vehicle mid-size SUV crashes (about 5%). Of the 22,459, the number of single vehicle mid-size SUV highway crashes is 10,572. Of these, 550 are tire-related (5%) and 10,022 are non-tire related (95 %).

The information contained in this document has not yet been presented to congress.

VEHICLE POPULATION FOR ANALYSIS

- SUV single vehicle highway crashes from 1994-1999 (all model years).
- SUVs were identified based on three external lists identifying SUVs: (1) J.D. Powers (JDPA) customer satisfaction surveys from the following years: 1999, 1997, 1996, and 1995; (2) NHTSA's list of SUVs Crash-Tested by NHTSA Model Years 1990-2001, and (3) all SUVs identified in the 2001 Offical JDPA Vehicle Segmentation Guide list including the following segments: Entry SUV Segment, Midsize SUV segment, Full Size SUV Segment, and Luxury SUV segment. The complete list of SUVs and the specific SUVs identified in the Texas database are included in Appendix A to this document.
- From the complete SUV list, mid-size SUVs were identified based on two criteria. First, we included vehicles with weights similar to the Ford Explorer. Second, we included all vehicles identified as midsize in the JDPA market segment list (the Ford Explorer is identified as mid size) unless the weight was more similar to the Ford Expedition than to the Ford Explorer.

Variable Definitions

- Single Vehicle – number of vehicles involved in the crash is equal to 1 (NUM_VEH = 1).
- Highway – Crash occurred on an interstate, US/State Highway, or Tollway (RD_CLASS = 1, 2, or 6)
- Make and Model (MK-MDL) – 3 digit code identifying vehicle manufacturer and model name (MK_MDL). This variable has no missing values.
- Explorer and Navajo - Make and model is equal to Ford Explorer (MK_MDL = 554) or Mazda Navajo (MK_MDL = 468).
- Other Mid Size SUVs – all SUV makes and models identified in Appendix A for Texas except the Ford Explorer and the Mazda Navajo.
- Tire-related Incident – The vehicle defect is identified as defective tires. This field is coded only if the defect was a factor in the crash (VEHICOND1 = 5).
- Rollover – The first harmful event that took place in the crash is identified as overturned (EVENT1 = 0). Note that a second variable is available that can be used in conjunction with the first harmful event to describe the crash in more detail (OBJECT1) which also includes a rollover field. Because this was NOT the first harmful event, the OBJECT1 variable is not used in defining a rollover.
- Fatality Incident – The accident severity is identified as fatal (SEVERITY = 4) or injury severity is killed (INJ = 4)..

The pages from the User's Manual for the State Data System-Texas that describe the variables listed above are provided in Appendix B to this document.

Results

Table 1 shows the rollover comparison between the Ford Explorer/Navajo and other mid-size SUVs for single vehicle highway tire-related incidents in Texas (550 incidents). The likelihood of a rollover for:

- The Ford Explorer/Mazda Navajo is 63.6%.
- Other mid-size SUVs is 52.52%.

The likelihood ratio is 1.211 and the 90% confidence bounds (which shows a 5% test on each side) are 1.074 to 1.366. This ratio is significantly different than 1.0. If both vehicles were the same in regards to the tire-related rollover probability, we would expect the ratio to be 1.0. Hence, we conclude that the vehicles are different.

The odds of a rollover for:

- The Ford Explorer/Mazda Navajo is 1.75
- Other mid-size SUVs is 1.11.

The ratio of the odds is 1.58.

TABLE 1. SINGLE VEHICLE HIGHWAY TIRE RELATED ACCIDENTS IN TEXAS-ROLLOVERS: ACCIDENT YEARS 1994-1999

Vehicle Type	Tire Related Single Vehicle Highway Accidents in Texas		
	Rollover	No Rollover	Total
Explorers and Navajos	173 (63.6)	99 (36.4)	272 (49.5)
Other Mid-Size SUVs	146 (52.5)	132 (47.5)	278 (50.6)
Total	319	231	550

Table 2 shows the fatality incident comparison between the Ford Explorer/Navajo and other mid-size SUVs for single vehicle highway tire-related incidents in Texas (550 incidents). The likelihood of a fatality incident for:

- The Ford Explorer/Mazda Navajo is 5.5%.
- Other mid-size SUVs is 1.4%.

The likelihood ratio is 3.833 and the 90% confidence bounds (which shows a 5% test on each side) are 1.535 to 9.569. This ratio is significantly different than 1.0. If both vehicles were the same in regards to the tire-related fatality incident probability, we would expect the ratio to be 1.0. Hence, we conclude that the vehicles are different.

The odds of a fatality incident for:

- The Ford Explorer/Mazda Navajo is 0.058.
- Other mid-size SUVs is 0.015.

The ratio of the odds is 3.87.

TABLE 2. SINGLE VEHICLE HIGHWAY TIRE RELATED ACCIDENTS IN TEXAS- FATALITY INCIDENTS: ACCIDENT YEARS 1994-1999

Vehicle Type	Tire Related Single Vehicle Highway Accidents in Texas		
	Fatality Incident	Non Fatality Incident	Total
Explorers and Navajos	15 (5.5)	257 (94.5)	272 (49.5)
Other Mid-Size SUVs	4 (1.4)	274 (98.6)	278 (50.6)
Total	19	531	550

APPENDIX A

MID-SIZE SUV REFERENCE LIST AND SUVS IDENTIFIED IN TEXAS CRASH DATABASE (IF MIDSIZE LIST = 1)

THE Mid-Size SUV LIST

Make	Model	X if SUV is in Florida Crash database	X if SUV is in Texas Crash database	JD Power Market Segment	Gross Weight (Min)	Gross Weight (Max)	Midsize List
AM General	Hummer H3			Midsize	NA	NA	
Buick	Rendezvous			Midsize	NA	NA	
Chevrolet	Blazer	X	X	Midsize	4450	5300	1
Chevrolet	S-10 Blazer	X	X	Midsize	4350	5100	1
Chevrolet	Trailblazer			Midsize	NA	NA	
Chrysler	Citadel			Midsize	NA	NA	
Dodge	Durango	X		Midsize	6050	6400	
Ford	CrossTrainer Wagon			Midsize	NA	NA	
Ford	Explorer	X	X	Midsize	4760	5560	1
Ford	Ranger SUV			Midsize	4420	5120	1
GMC	Envoy			Midsize	NA	NA	
GMC	Jimmy	X	X	Midsize	4450	5300	1
GMC	Jimmy Sonoma	X	X	Midsize	4450	5300	1
GMC	Jimmy/Envoy	X		Midsize	4450	5300	1
Honda	MAV			Midsize	NA	NA	
Honda	Passport	X	X	Midsize	3958	3958	1
Isuzu	Axiom			Midsize	3920	4180	1
Isuzu	Rodeo	X	X	Midsize	4550	4900	1
Isuzu	Rodeo/Rodeo Sport	X		Midsize	4550	4700	1
Isuzu	Trooper	X	X	Midsize	5350	5550	1
Isuzu	Trooper II	X	X	Midsize	5510	5510	1
Isuzu	VehiCROSS	X		Midsize	4852	4852	1
Jeep	Grand Cherokee	X	X	Midsize	4950	5600	1
Land Rover	Discovery	X	X	Midsize	4465	4576	1

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Mazda	Navajo	X	X	Midsize	3785	4184	1
Mazda	Nextourer			Midsize	NA	NA	
Mercury	Mountaineer	X	X	Midsize	4780	5560	1
Mitsubishi	Montero	X	X	Midsize	5732	5732	1
Mitsubishi	Montero Sport	X	X	Midsize	4730	5000	1
Nissan	Pathfinder	X	X	Midsize	3980	4075	1
Oldsmobile	Bravada	X	X	Midsize	4049	5300	1
Subaru	Lambda SUV			Midsize	NA	NA	
Toyota	4-Runner	X	X	Midsize	5250	5400	1
Toyota	Highlander			Midsize	4982	4982	1
Volkswagen	SUV			Midsize	NA	NA	
Acura	MDX			Luxury	5690	5690	1
Acura	SLX	X	X	Luxury	4315	4315	1
AM General	Hummer			Luxury	NA	NA	
BMW	X3			Luxury	NA	NA	
BMW	X5	X		Luxury	4795	4795	1
BMW	X7			Luxury	NA	NA	
Cadillac	Crossover			Luxury	NA	NA	
Cadillac	Escalade	X		Luxury	5572	5572	
Cadillac	LAV			Luxury	NA	NA	
Infiniti	Crossover			Luxury	NA	NA	
Infiniti	Fullsize SUV			Luxury	NA	NA	
Infiniti	QX4	X	X	Luxury	4275	4275	1
Land Rover	DiscoverySeriesII	X	X	Luxury	4576	4630	1
Land Rover	Range Rover	X	X	Luxury	4828	4828	1
Lexus	LX 450	X	X	Luxury	4751	4751	1
Lexus	LX 470	X		Luxury	5401	5401	
Lexus	RX300	X		Luxury	3789	3925	
Lincoln	Compact SUV			Luxury	NA	NA	
Lincoln	LAV			Luxury	NA	NA	

Lincoln	Navigator	X		Luxury	6750	7200	
Mercedes Benz	Crossover SUV			Luxury	NA	NA	
Mercedes Benz	M-Class			Luxury	NA	NA	
Mercedes Benz	ML-Class (ML320)	X		Luxury	NA	NA	
Mercedes Benz	MLG			Luxury	NA	NA	
Porsche	Cayenne			Luxury	NA	NA	
Saab	SUV			Luxury	NA	NA	
Toyota	LandCruiser	X	X	Luxury	6470	6860	
Volvo	SUV			Luxury	NA	NA	
AM General	Hummer H2			Fullsize	6964	6964	
Chevrolet	Suburban	X	X	Fullsize	6800	8600	
Chevrolet	Tahoe	X	X	Fullsize	6100	6800	
Ford	Bronco	X	X	Fullsize	6000	6450	
Ford	Excursion	X		Fullsize	8800	9200	
Ford	Expedition	X	X	Fullsize	6700	7200	
GMC	Denali	X		Fullsize	5583	5583	
GMC	Suburban	X	X	Fullsize	6800	8600	
GMC	Typhoon	X		Fullsize	4700	4700	1
GMC	Yukon	X	X	Fullsize	6800	6800	
GMC	Yukon Denali	X	X	Fullsize	6800	6800	
GMC	Yukon XL	X	X	Fullsize	6800	6800	
GMC	Yukon XL Denali	X	X	Fullsize	6800	6800	
Nissan	Fullsize SUV			Fullsize	NA	NA	
Toyota	Sequoia			Fullsize	6500	6600	
Chevrolet	Tracker	X		Entry	3080	3924	
Chevrolet	Traverse			Entry	NA	NA	
Chrysler	Korando			Entry	NA	NA	
Chrysler	Musso			Entry	NA	NA	
Ford	Escape			Entry	4100	4570	1
Geo	Tracker	X	X	Entry	2189	2189	

Honda	CR-V		X	Entry	3164	3164	
Hyundai	Santa Fe			Entry	4950	5240	
Isuzu	Amigo	X	X	Entry	4100	4500	1
Jeep	Cherokee	X	X	Entry	4550	4900	1
Jeep	Liberty			Entry	NA	NA	
Jeep	Varsity			Entry	NA	NA	
Jeep	Wrangler	X	X	Entry	4300	4450	1
Kia	Sportage	X	X	Entry	4296	5896	1
Land Rover	Defender	X	X	Entry	3600	3600	
Land Rover	Freelander			Entry	NA	NA	
Mazda	Tribute			Entry	NA	NA	
Mitsubishi	Dingo			Entry	NA	NA	
Nissan	Crossover			Entry	NA	NA	
Nissan	Xterra	X		Entry	3504	3858	
Pontiac	Aztek			Entry	NA	NA	
Saturn	VUE			Entry	NA	NA	
Subaru	Forester	X		Entry	3125	3125	
Suzuki	Grand Vitara	X		Entry	3375	3500	
Suzuki	Samurai	X	X	Entry	2870	2932	
Suzuki	Sidekick	X	X	Entry	3086	3682	
Suzuki	Vitara	X		Entry	2875	3375	
Suzuki	X90	X	X	Entry	2734	2954	
Suzuki	XL7			Entry	NA	NA	
Toyota	Rav4	X	X	Entry	3550	3948	

APPENDIX B

USER'S MANUAL DEFINITIONS OF VARIABLES USED IN ANALYSIS

(NOT ATTACHED)

Attachment 5

Sea SUV1,Red Ford Explorer 1996

Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Last Calib. Date:
DAS-2030	955009	945009	Data acquistion system	LINK	analog/digital		Link Engineering	T.R.C. Inc.	16-Mar-01
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
5th-140.0027	140.0027	DRS6 Radar	A_DAT Radar 5th wheels	A_DAT	Feet/Meter's	Calibrated per measured mile records in file cabinet	A-DAT	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-30105282	30105282	LX-PA-20	STRING POT	UNIMEASURE	INCHES	Calibrated with String pot guage blocks	UNIMEASURE	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-167627	167627	141A	2 G Acceleromete r	Setra	G's	B.U. S2 bldg 30 calibration	Setra	T.R.C. Inc.	06/27/2000
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=158	158	10B-033911	HP Gyro Rate Gyro's	PI Research Inc.	DEGREES	Outside vendor Calibration PI Reseach Inc.	PI Research Inc.	T.R.C. Inc.	05/08/2001
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-C0839	C0839	USCA-TX	20G ACCELEROM ETER	CFX	G's		CFX	T.R.C. Inc.	11/10/1999
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-A23706	A23706	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-10653800	10653800	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=CO1153	CO1153	UCG-1	Rate Gyro	CFX	Degrees		CFX		05/08/2001
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=102	102		Humphery Rate Gyro's	Humphery	DEGREES		Huphery	VRTC	

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Sea SUV2,Green Chevrolet Blazer

Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Last Calib. Date:
DAS-2050	955032	945009	Data acquistion system	LINK	analog/digital		Link Engineering	T.R.C. Inc.	29-Jan-01
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
5th-#55loaner	#55loaner	DR56 Radar	A_DAT Radar 5th wheels	A_DAT	Feet/Meter's	Calibrated per measured mile records in file cabinet	A-DAT	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-301110495	301110495	LX-PA-20	STRING POT	UNIMEASURE	INCHES	Calibrated with String pot guage blocks	UNIMEASURE	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=0116	166		HP Gyro Rate Gyro's	Watson.	DEGREES	Outside vendor Calibration	Watson	VRTC	05/08/2001
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-C0840	C0840	USCA-TX	20G ACCELEROM ETER	CFX	G's		CFX	T.R.C. Inc.	11/10/1999
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-10653798	10653798	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-H0601324	H0601324	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test

Sea SUV3,White Ford Explorer 2001

Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Last Calib. Date:
DAS-2030	955009	945009	Data acquistion system	LINK	analog/digital		Link Engineering	T.R.C. Inc.	16-Mar-01
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
5th-140.0027	140.0027	DRS6 Radar	A_DAT Radar 5th wheels	A_DAT	Feet/Meter's	Calibrated per measured mile records in file cabinet	A-DAT	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-30105282	30105282	LX-PA-20	STRING POT	UNIMEASURE	INCHES	Calibrated with String pot guage blocks	UNIMEASURE	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-167627	167627	141A	2 G Acceleromete r	Setra	G's	B.U. 52 bldg 30 calibration	Setra	T.R.C. Inc.	06/27/2000
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=158	158	108-033911	HP Gyro Rate Gyro's	PI Research Inc.	DEGREES	Outside vendor Calibration PI Reseach Inc.	PI Research Inc.	T.R.C. Inc.	05/08/2001
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-C0839	C0839	USCA-TX	20G ACCELEROM ETER	CFX	G's		CFX	T.R.C. Inc.	11/10/1999
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-A23706	A23706	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-10653800	10653800	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=CO1153	CO1153	UCG-1	Rate Gyro	CFX	Degrees		CFX		05/08/2001

Sea SUV4, Chrokee

Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
DAS-2101	2101	2060	Data acquistion system	LINK	analog/digital		Link Engineering	T.R.C. Inc.	08/11/2000
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
5th-140.0082	140.0082	DRS6 Radar	A_DAT Radar 5th wheels	A_DAT	Feet/Meter's	Calibrated per measured mile records in file cabinet	A-DAT	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-30110494	30110494	LX-PA-20	STRING POT	UNIMEASURE	INCHES	Calibrated with String pot guage blocks	UNIMEASURE	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-118555	118555	141A	2 G Acceleromete r	Setra	G's	B.U. 52 bldg 30 calibration	Setra	T.R.C. Inc.	06/27/2000
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
A-C0840	C0840	USCA-TX	20G ACCELEROM ETER	CFX	G's		CFX	T.R.C. Inc.	11/10/1999
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-H0601324	H0601324	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
SP-10653798	10653798	PT101-0030-111-5110	STRING POT	CELESCO	INCHES	Calibrated with String pot guage blocks	CELESCO	T.R.C. Inc.	Per test
Gage ID:	Gage S/N:	Model No.:	Description:	Type:	Unit of Meas.:	Notes:	Manufacturer:	Owner:	Calibration Date:
RTGY=CO1152	CO1152	UCG-1	Rate Gyro	CFX	Degrees		CFX		05/08/2001

Attachment 6

VEHICLE TESTING

May, 2001

PURPOSE

VEHICLES

- 1996 Ford Explorer
  - OEM Firestone Tires
  - OEM Goodyear Tires
- 1996 Chevrolet Blazer
- 2000 Ford Explorer
- 2001 Jeep Cherokee

DYNAMIC TESTS

Tests Performed so far:

- Constant 200 ft. Radius
  - Understeer/Oversteer
- Step Steer
  - Response Gains, Response Times, Overshoots
- Sinusoidal Steering Sweep
  - Frequency Response

All testing in linear range of vehicle response.

Instrumentation

Instruments were used to measure the following:

- Vehicle speed
- Lateral Acceleration
- Yaw rate
- Roll angle
- Steering wheel angle

Understeer/Oversteer Gradient in (deg/g)

For a Constant Radius Test

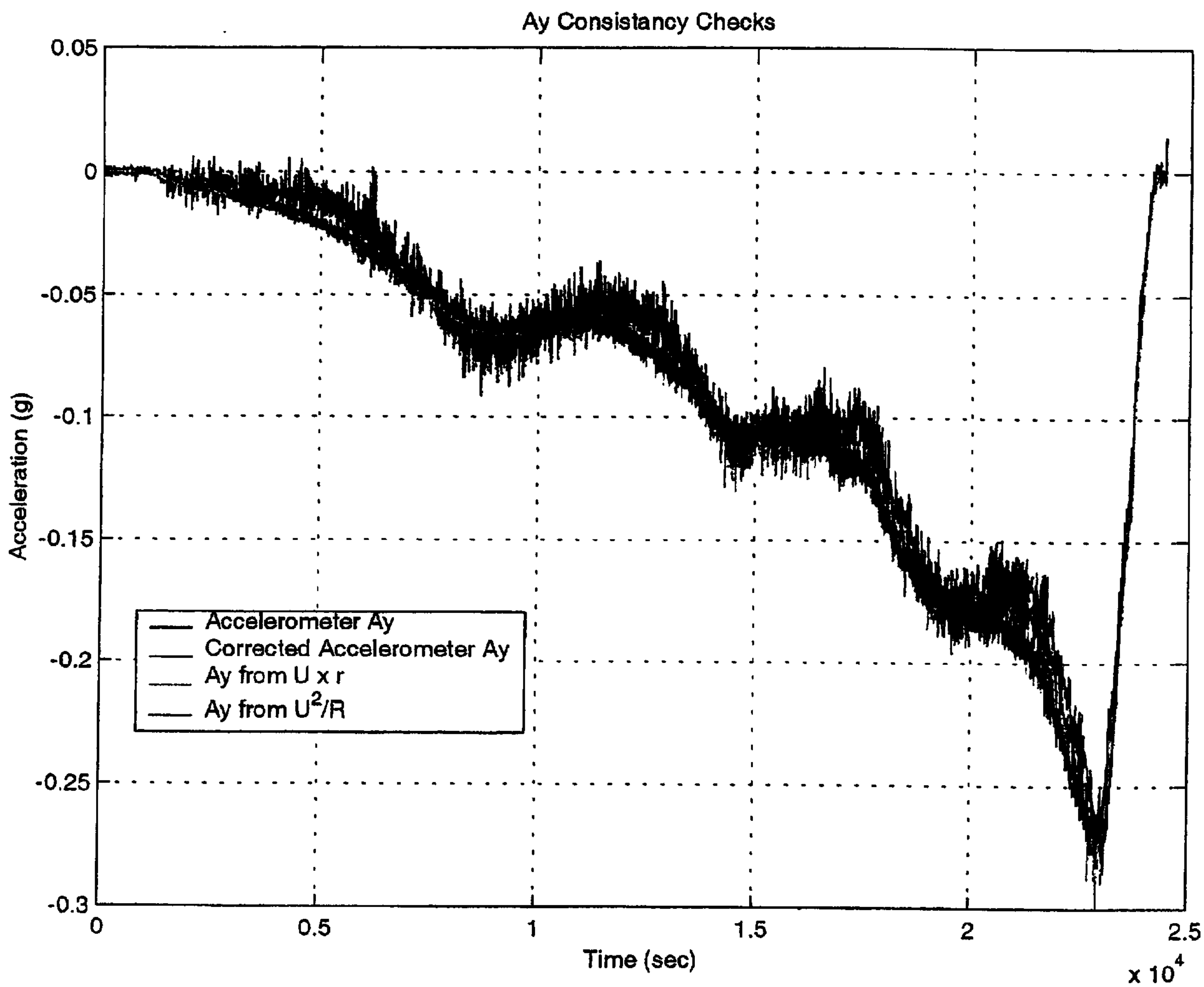
$$K = \frac{d\delta}{d(a/g)} \quad \text{(deg/g)}$$

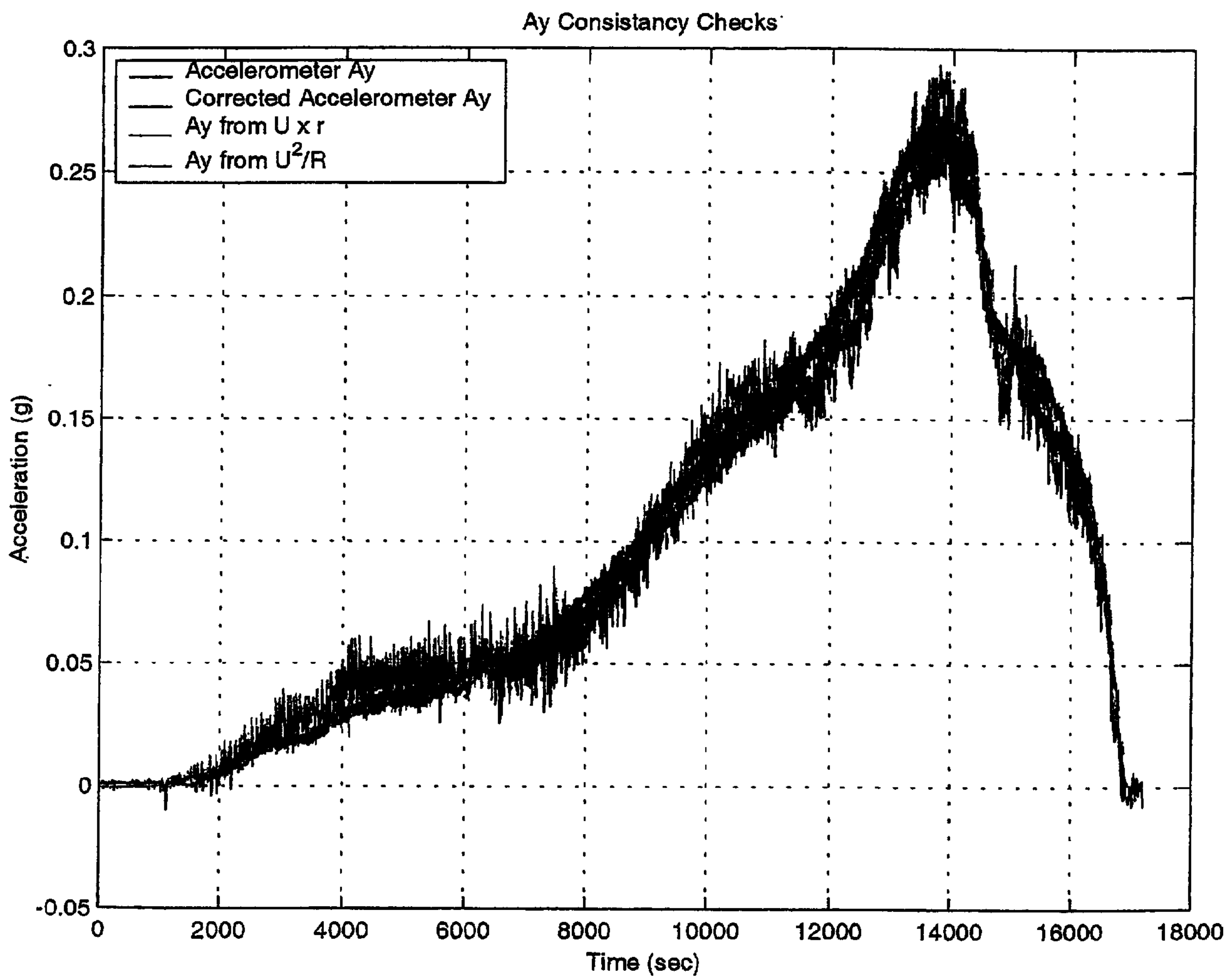
K: Understeer/Oversteer Gradient in (deg/g)

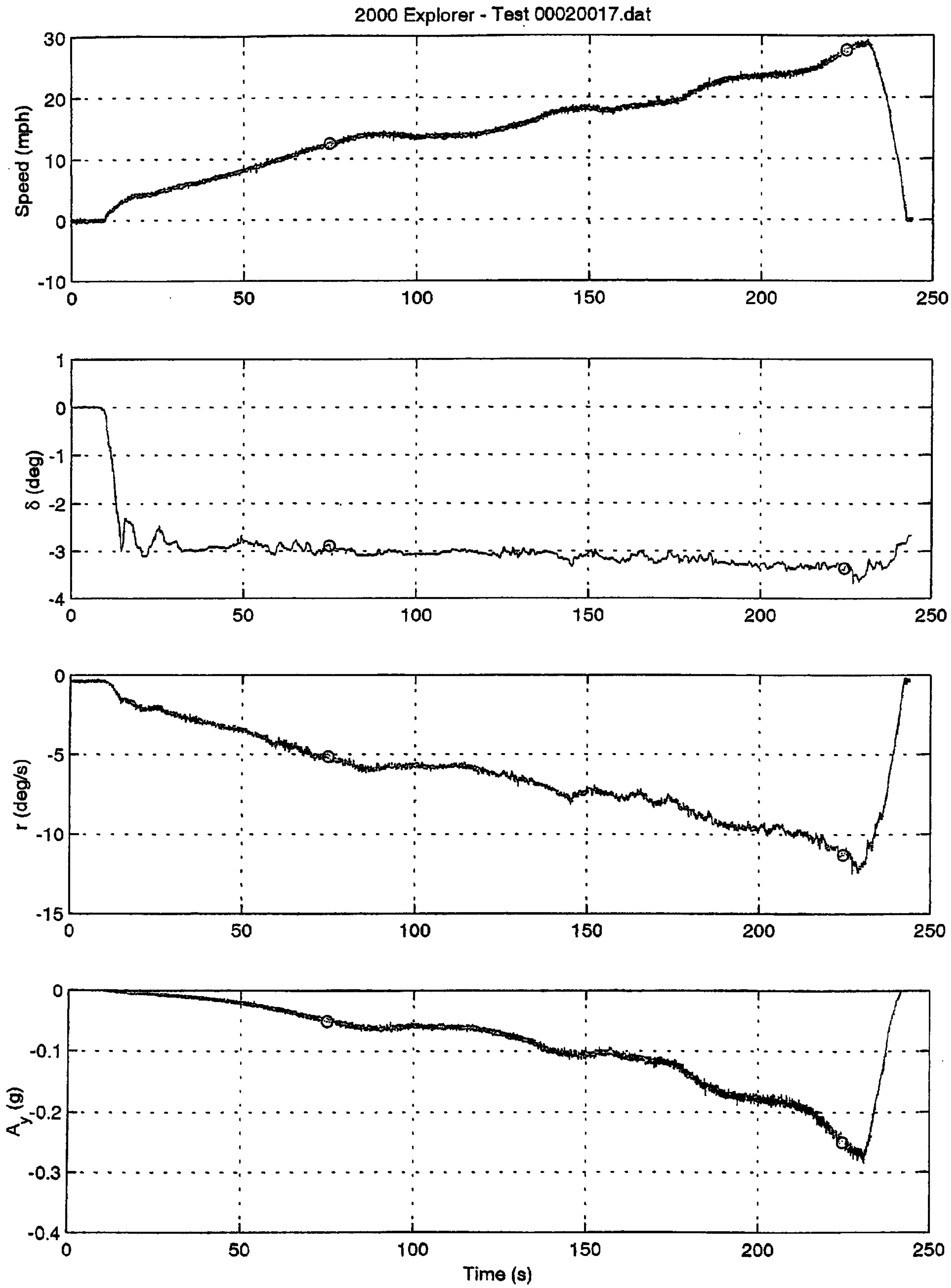
δ: Road Wheel Steer Angle
Handwheel Angle Divided by Steering Ratio

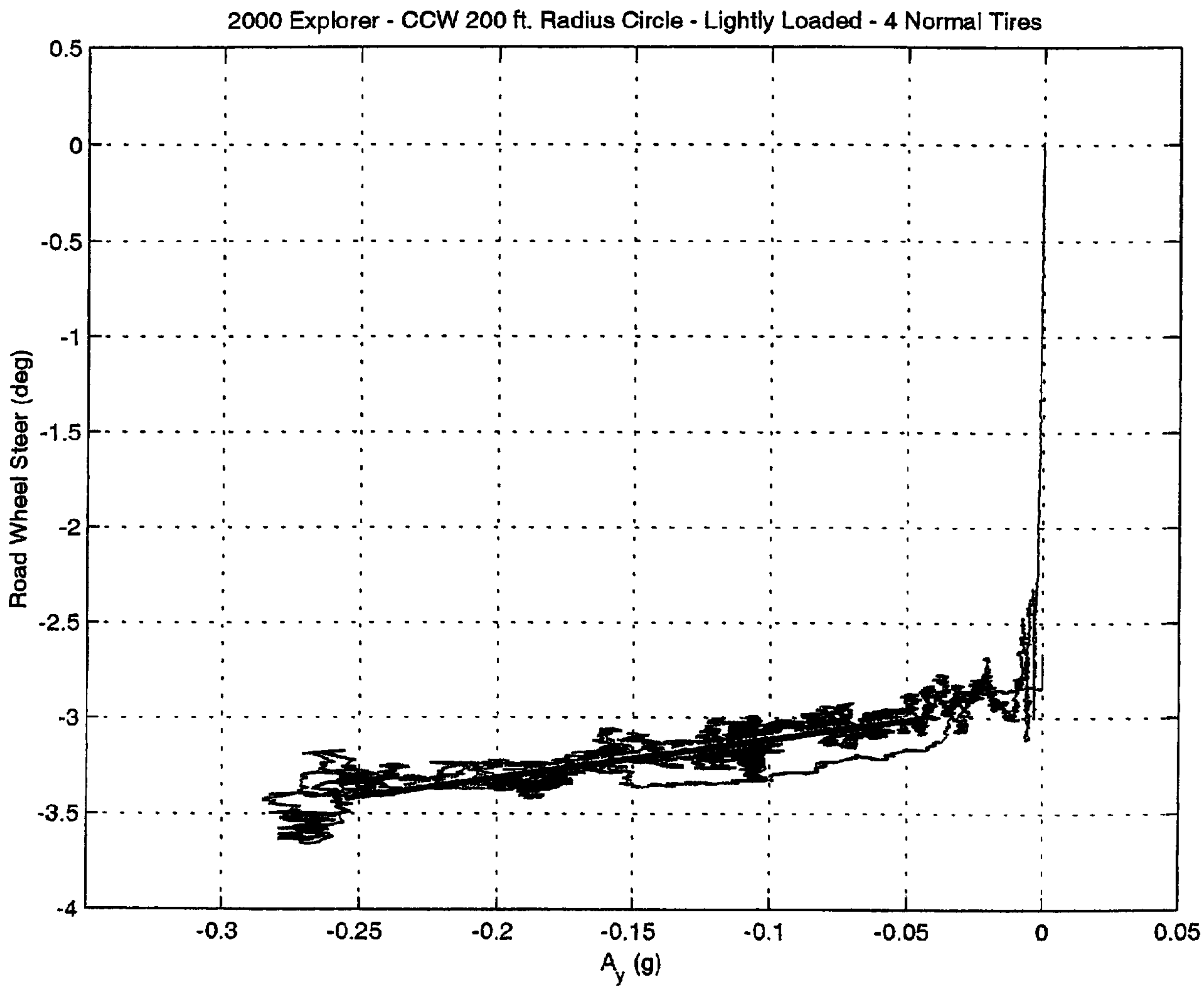
a: Lateral Acceleration

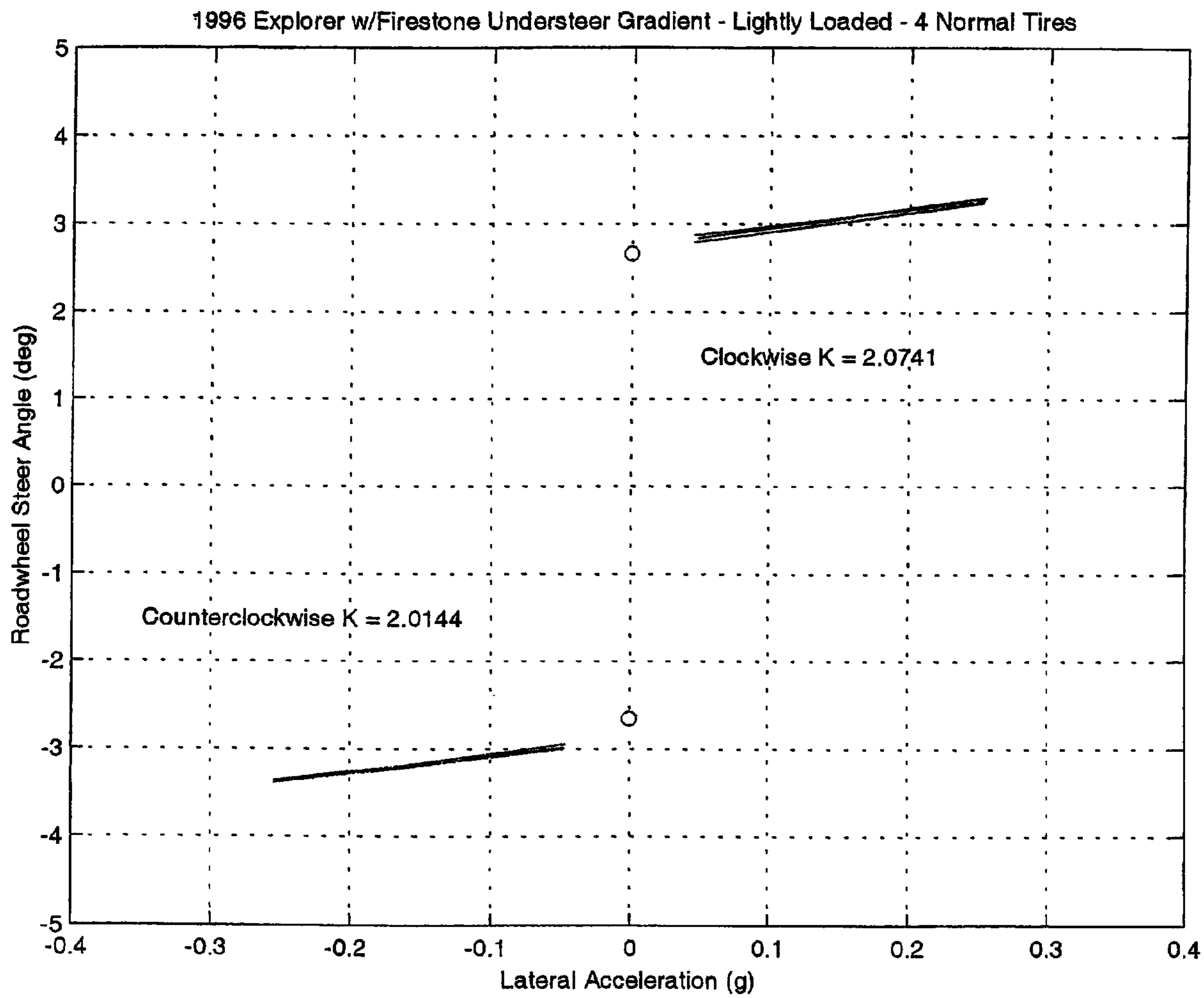
g: Gravitational Constant

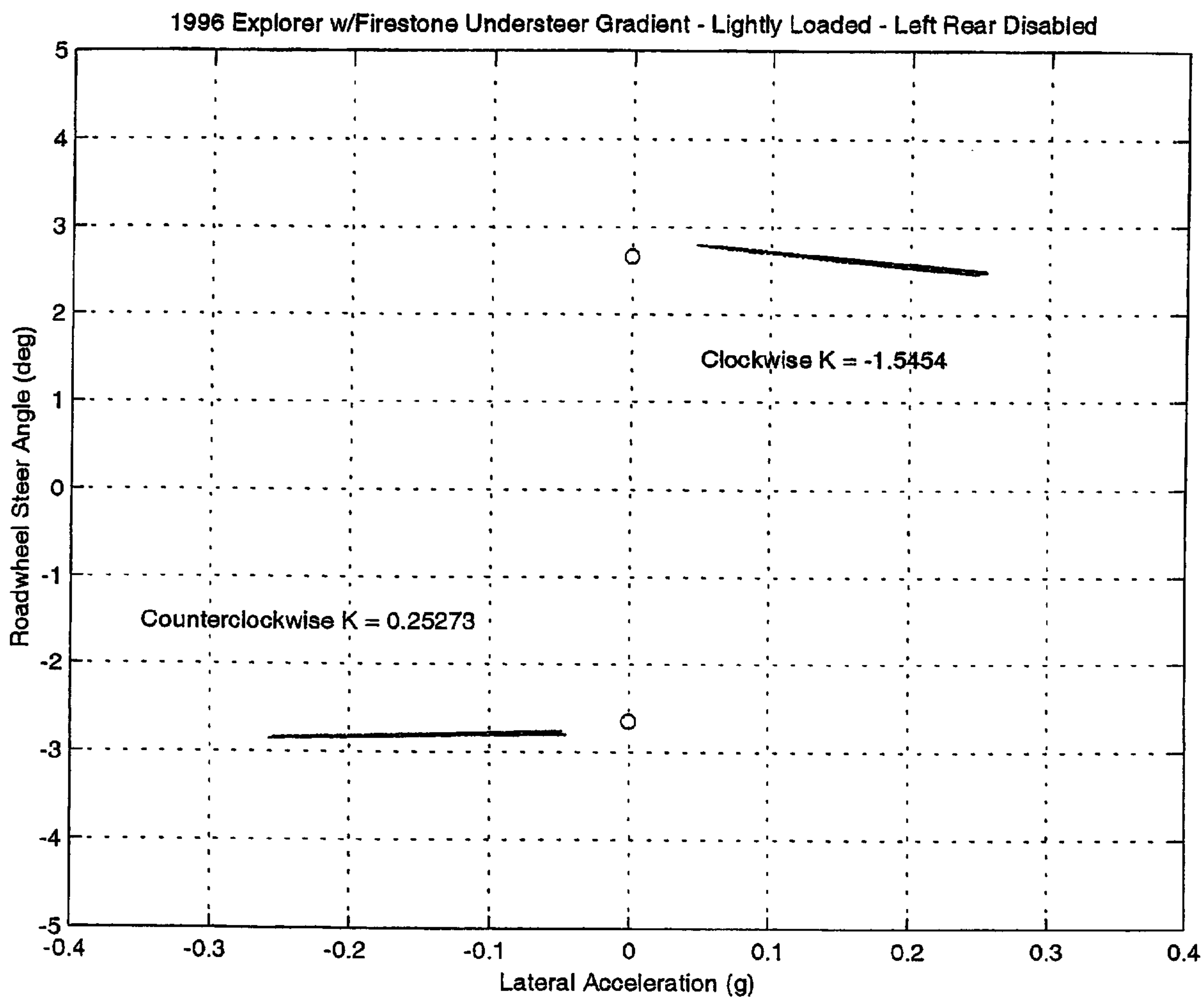

Ay Consistancy Checks
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.3
Acceleration (g)
0
0.5
1
1.5
2
2.5
Time (sec)
x 10^4
Accelerometer Ay
Corrected Accelerometer Ay
Ay from U x r
Ay from U^2/R


Ay Consistancy Checks
Accelerometer Ay
Corrected Accelerometer Ay
Ay from U x r
Ay from U2/R
Acceleration (g)
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Time (sec)

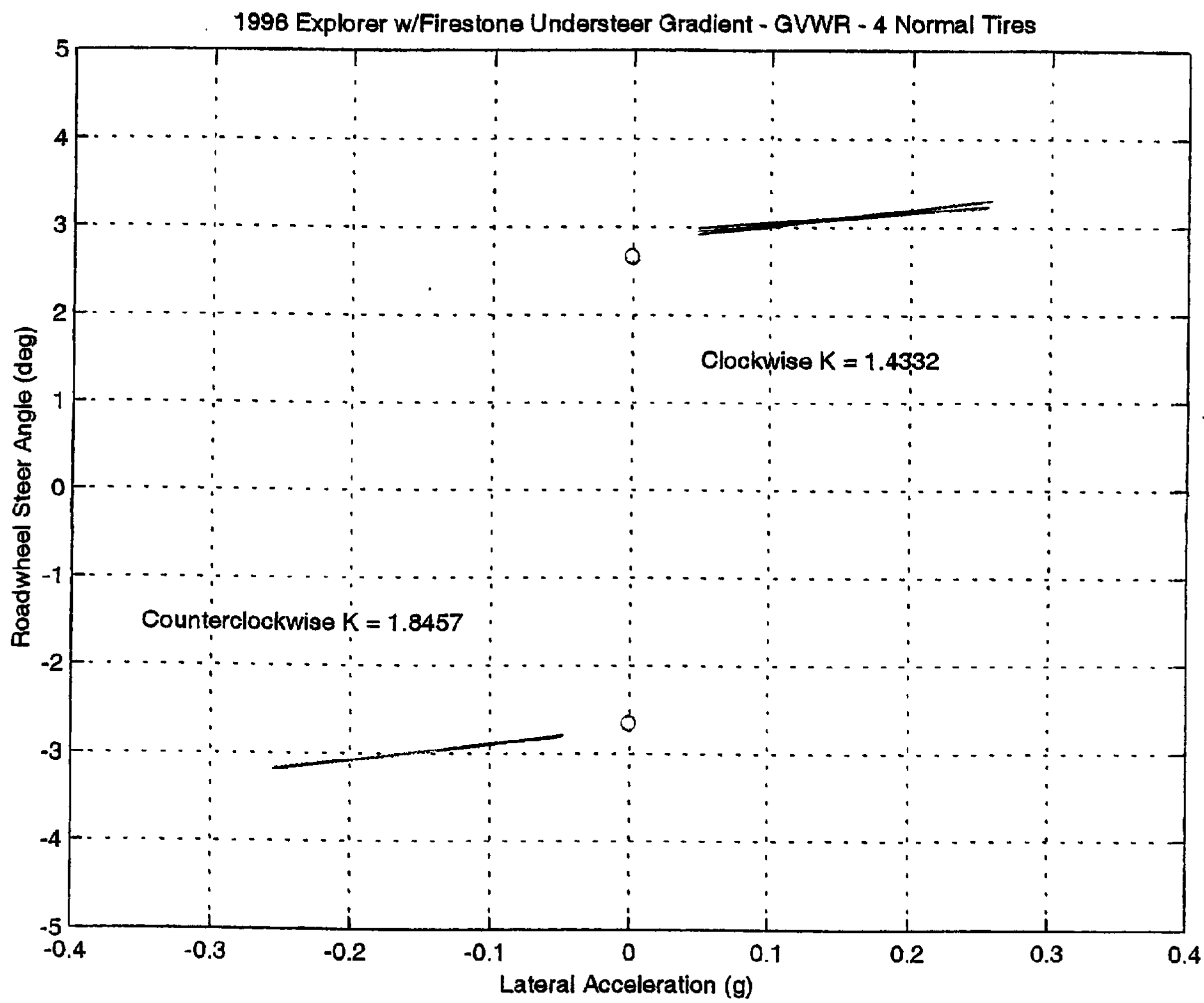

2000 Explorer - Test 00020017.dat
Speed (mph)
δ (deg)
r (deg/s)
A_y (g)
Time (s)

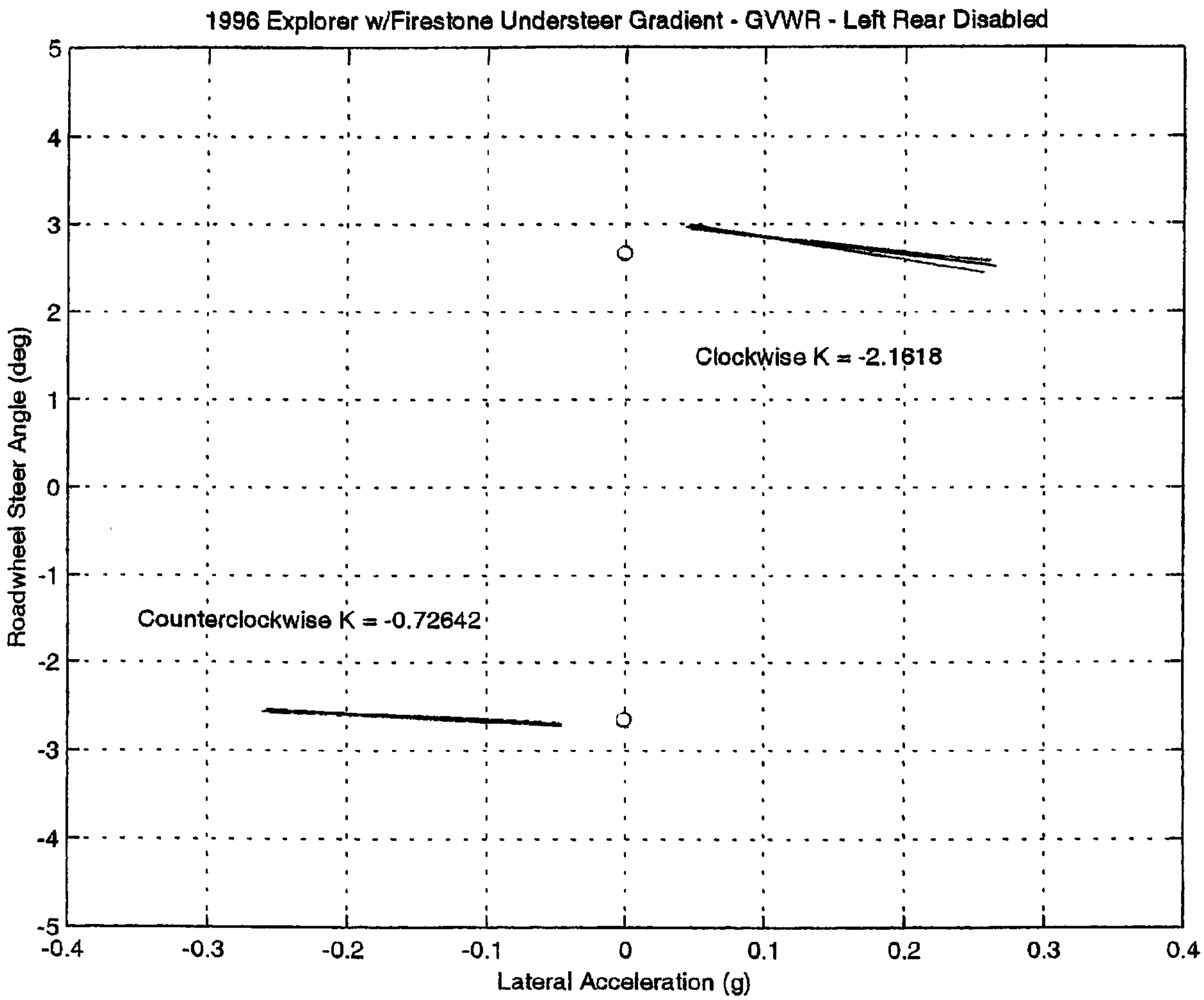

2000 Explorer - CCW 200 ft. Radius Circle - Lightly Loaded - 4 Normal Tires
Road Wheel Steer (deg)
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-0.3
-0.25
-0.2
-0.15
-0.1
-0.05
0
0.05
A_y (g)

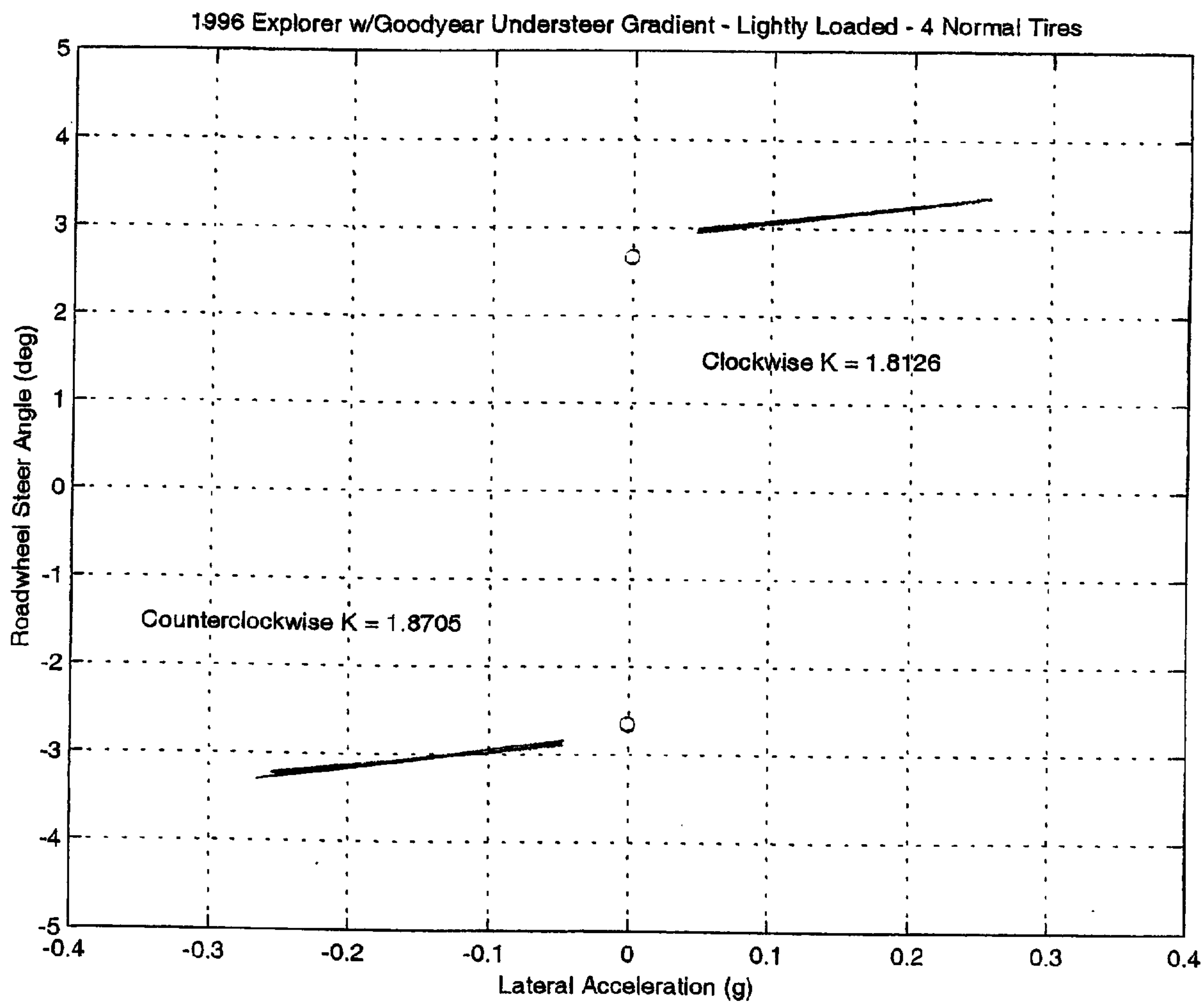

1996 Explorer w/Firestone Understeer Gradient - Lightly Loaded - 4 Normal Tires
Clockwise K = 2.0741
Counterclockwise K = 2.0144
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

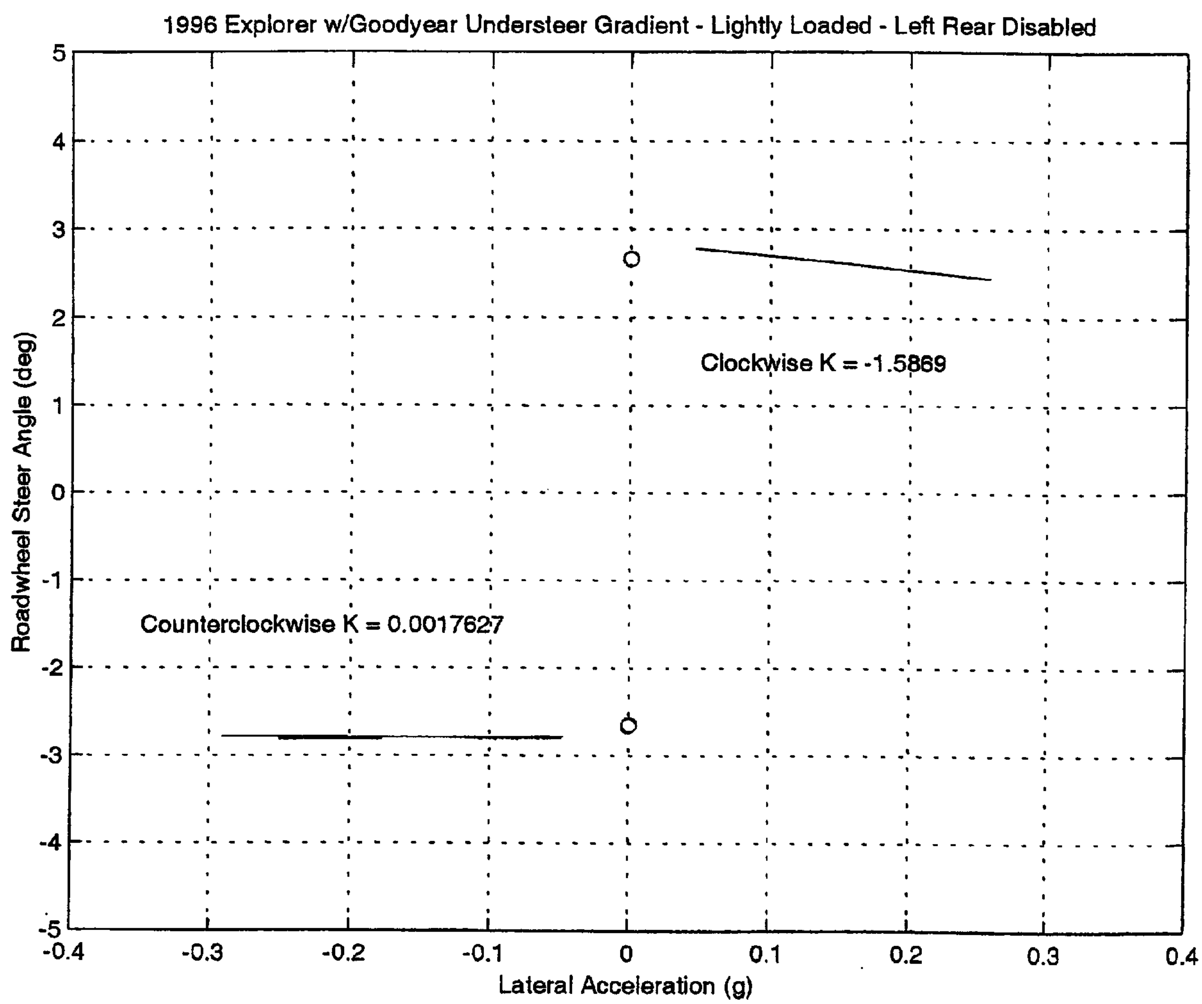


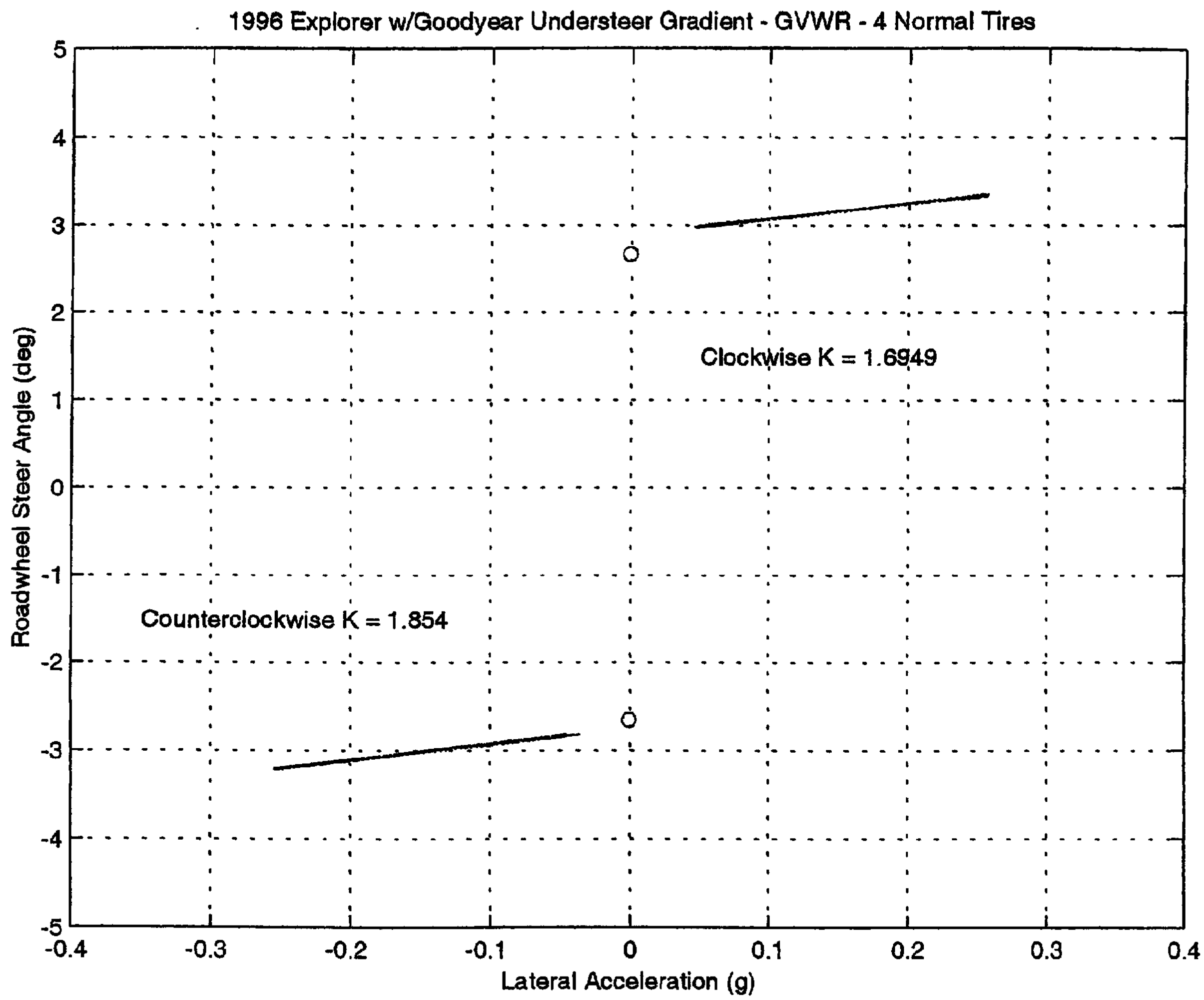
1996 Explorer w/Firestone Understeer Gradient - Lightly Loaded - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
Clockwise K = -1.5454
Counterclockwise K = 0.25273


1998 Explorer w/Firestone Understeer Gradient - GVWR - 4 Normal Tires
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 1.4332
Counterclockwise K = 1.8457
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

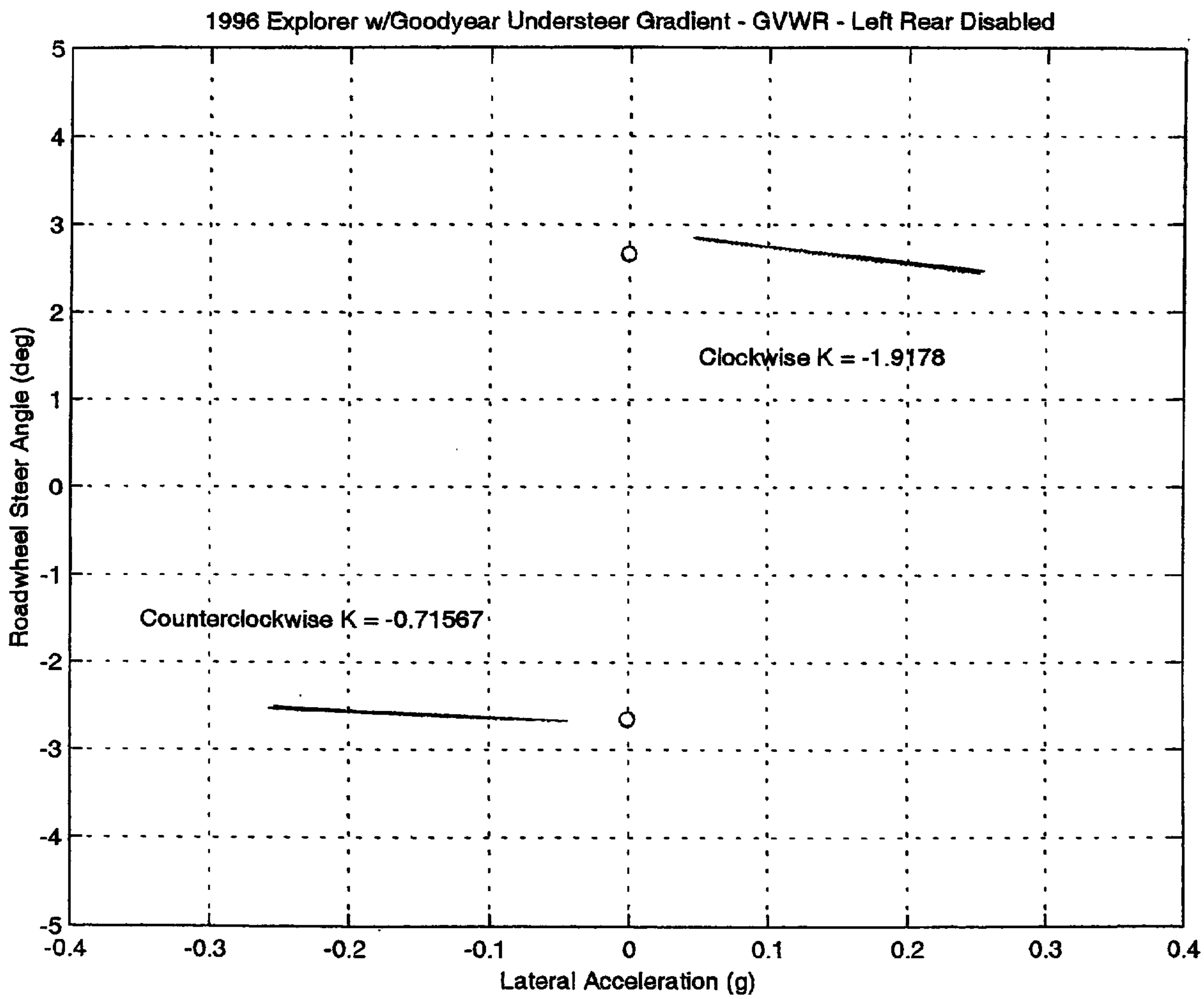

1996 Explorer w/Firestone Understeer Gradient - GVWR - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = -2.1618
Counterclockwise K = -0.72642
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

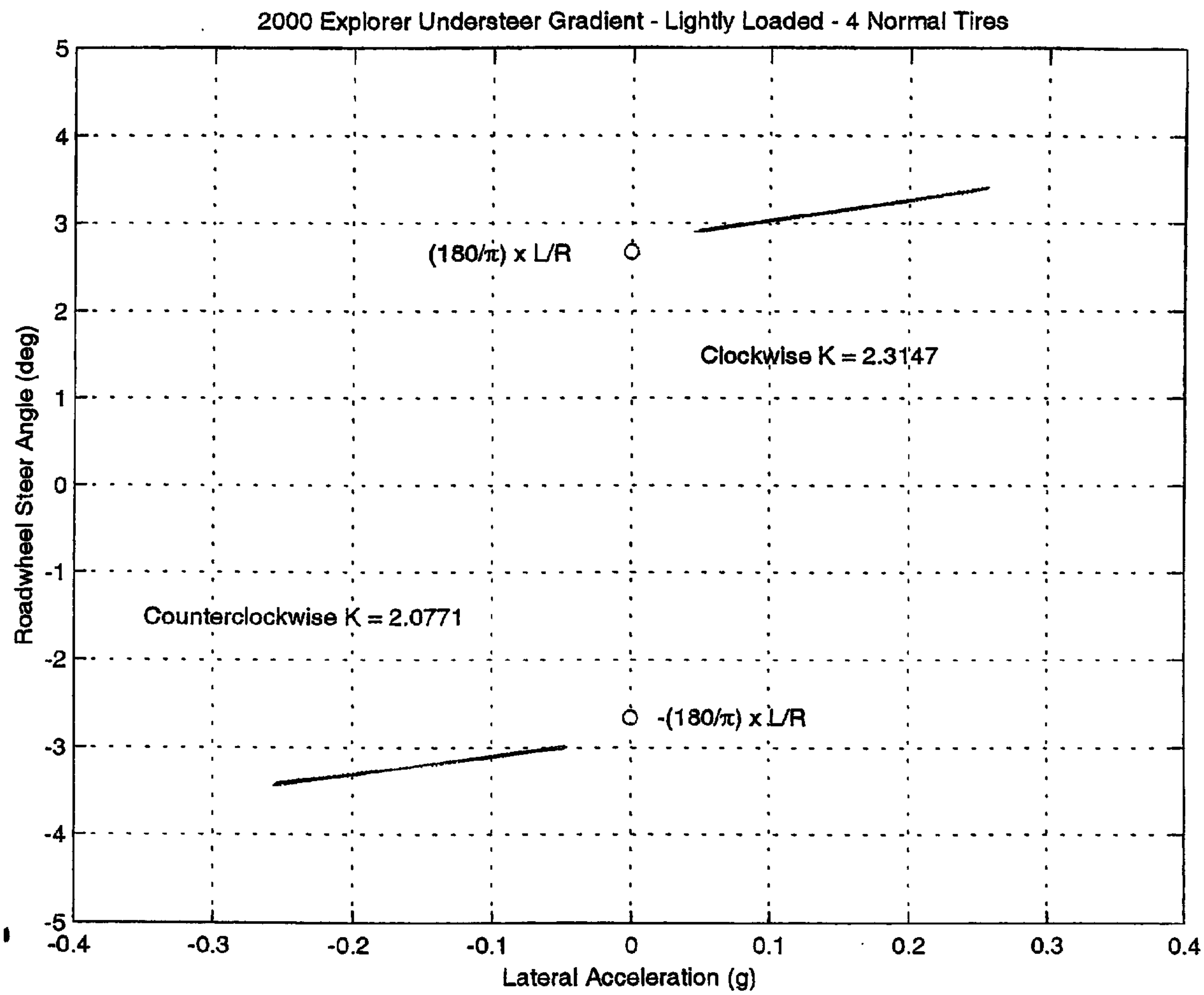

1996 Explorer w/Goodyear Understeer Gradient - Lightly Loaded - 4 Normal Tires
Roadwheel Steer Angle (deg)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
Lateral Acceleration (g)
Clockwise K = 1.8126
Counterclockwise K = 1.8705

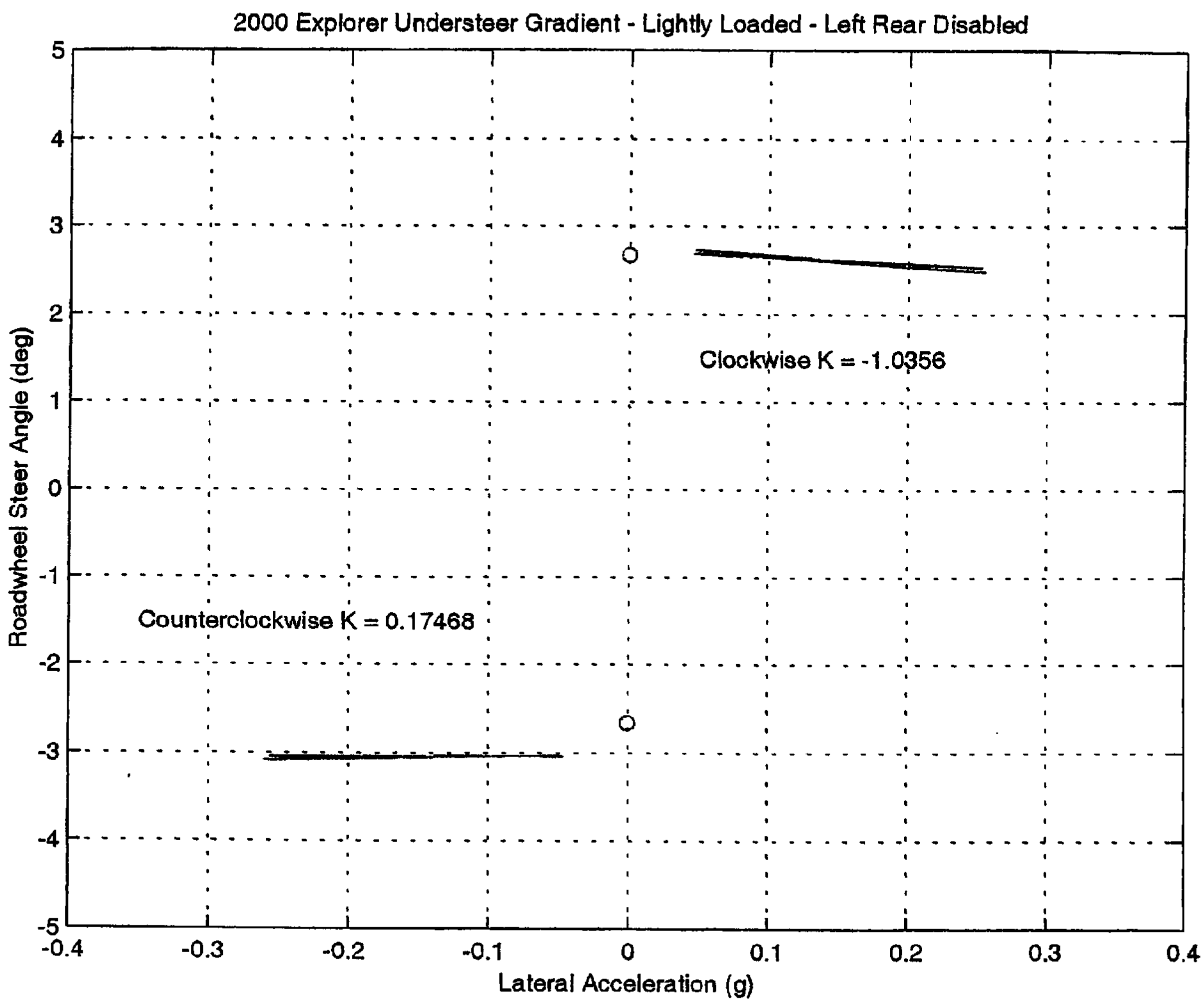

1996 Explorer w/Goodyear Understeer Gradient - Lightly Loaded - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = -1.5869
Counterclockwise K = 0.0017627
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

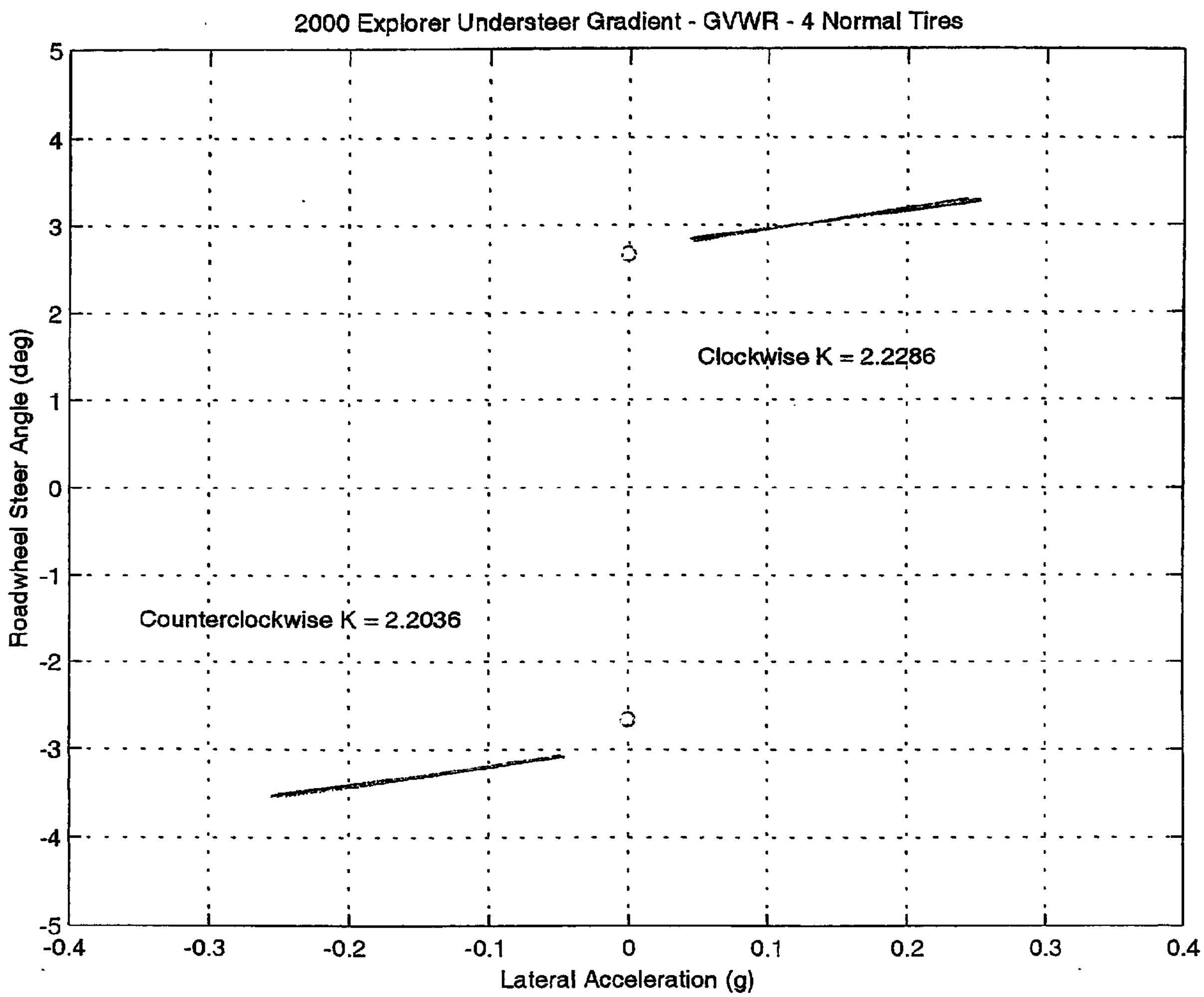


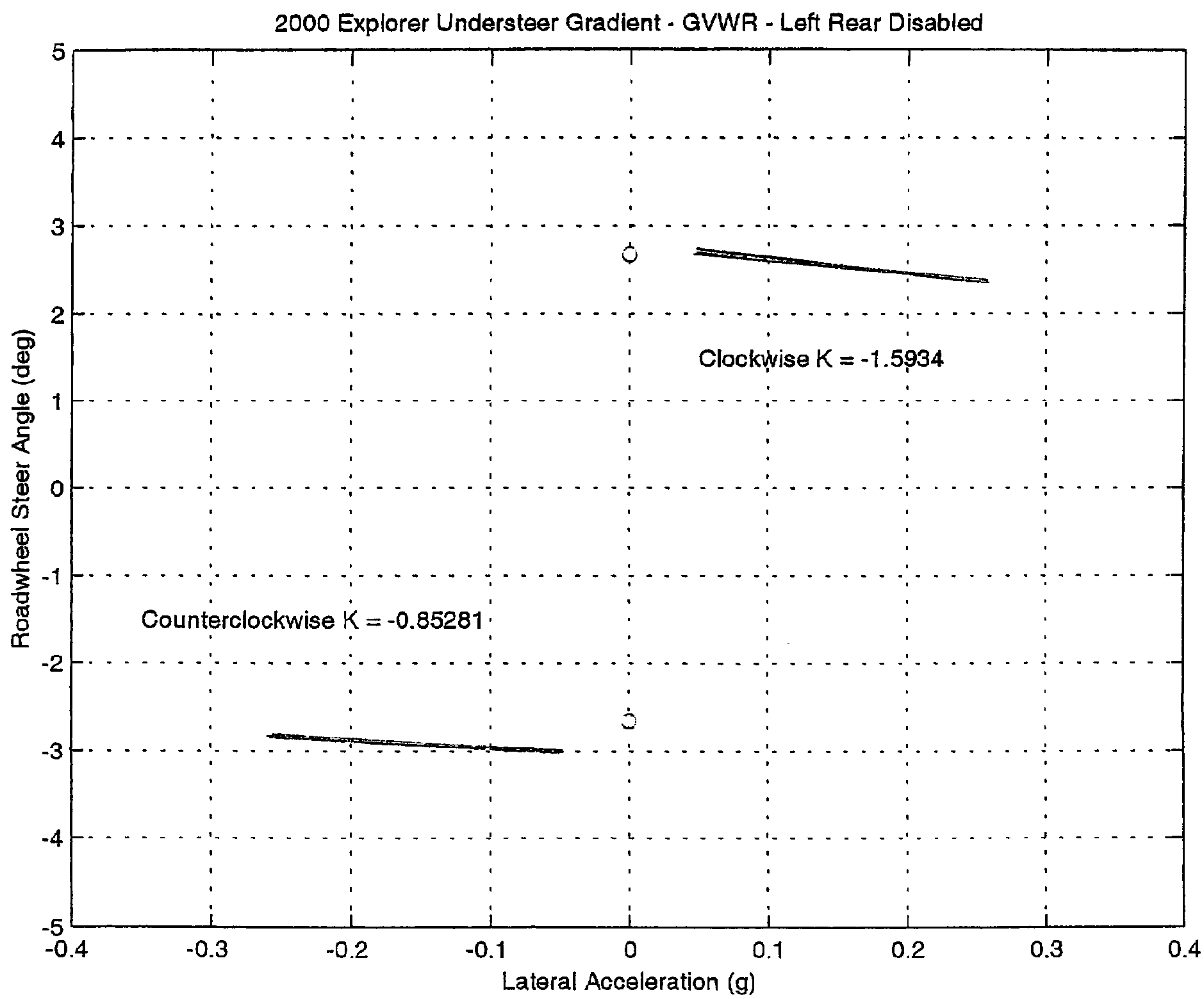
LAMPE_J-00130


1996 Explorer w/Goodyear Understeer Gradient - GVWR - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = -1.9178
Counterclockwise K = -0.71567
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

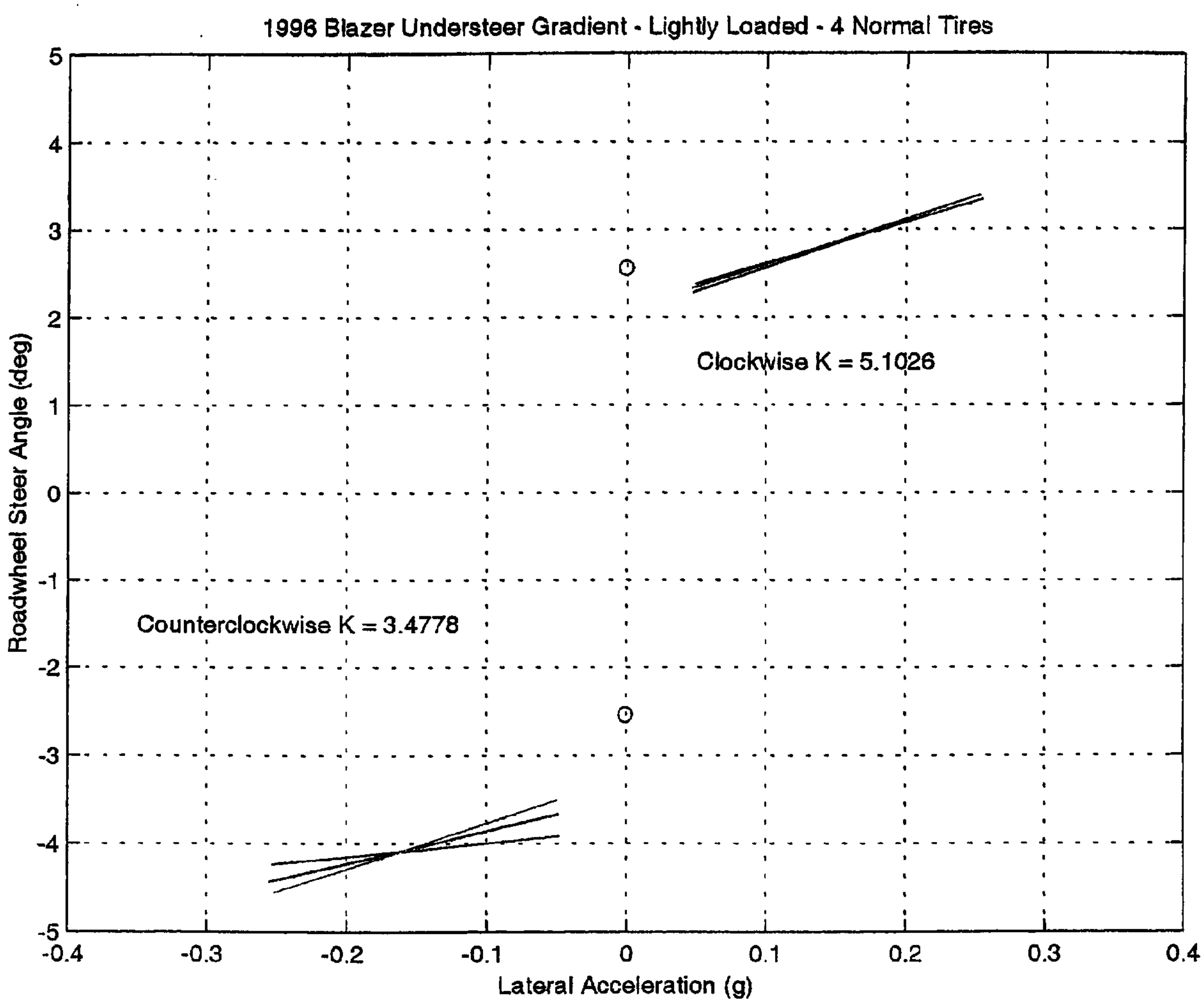

2000 Explorer Understeer Gradient - Lightly Loaded - 4 Normal Tires
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
(180/π) x L/R
Clockwise K = 2.3147
Counterclockwise K = 2.0771
-(180/π) x L/R
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

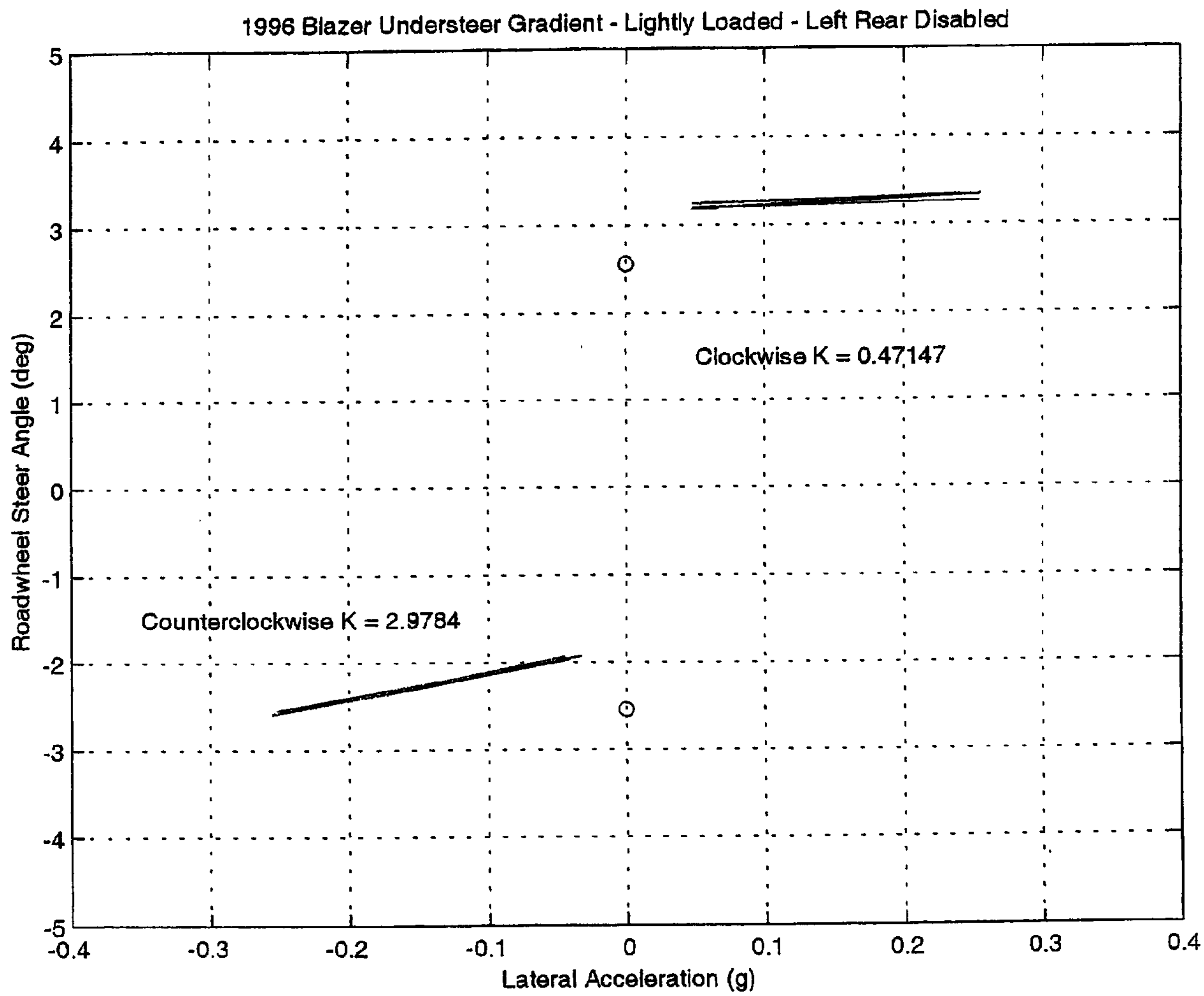

2000 Explorer Understeer Gradient - Lightly Loaded - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = -1.0356
Counterclockwise K = 0.17468
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

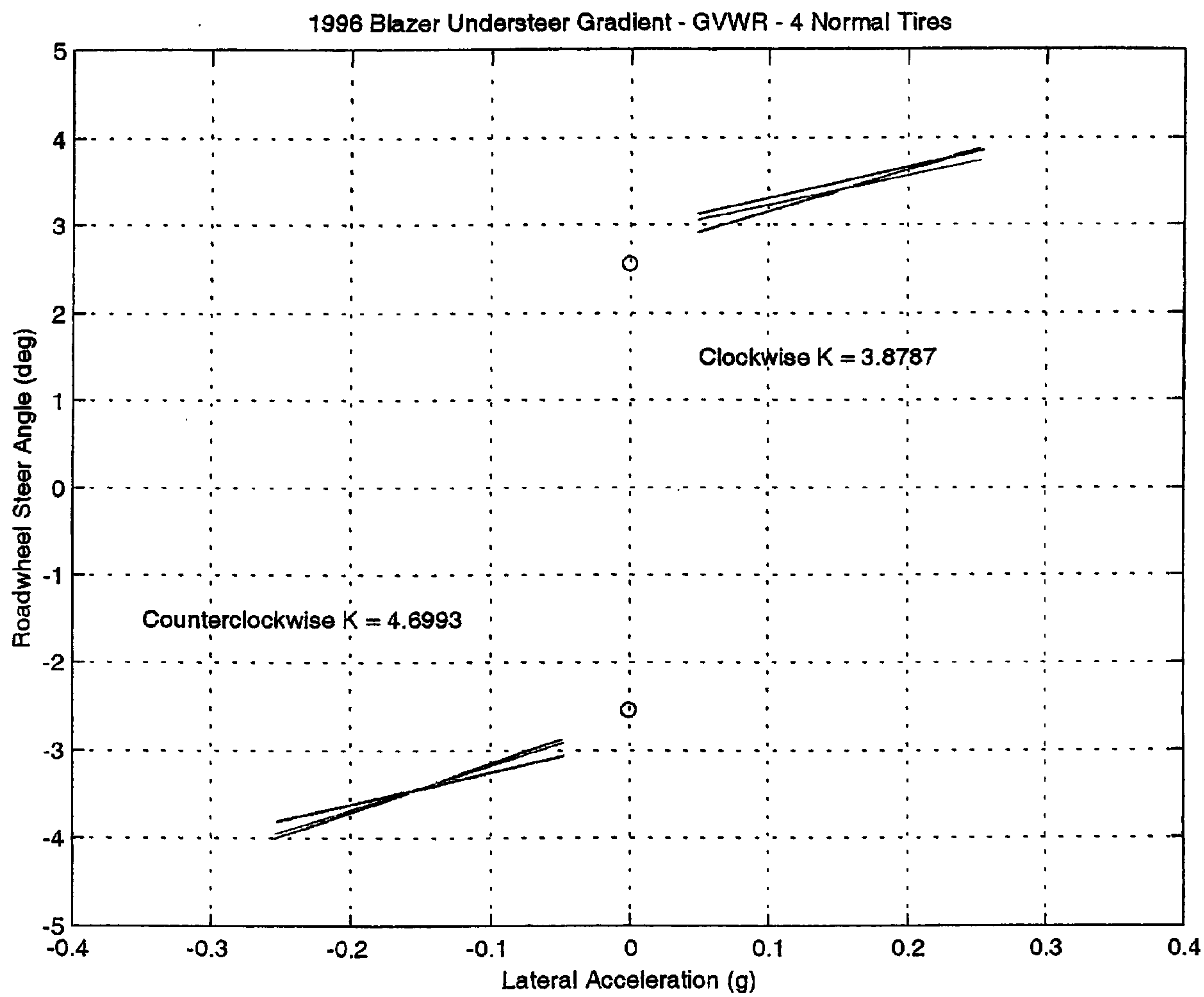

2000 Explorer Understeer Gradient - GVWR - 4 Normal Tires
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 2.2286
Counterclockwise K = 2.2036
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

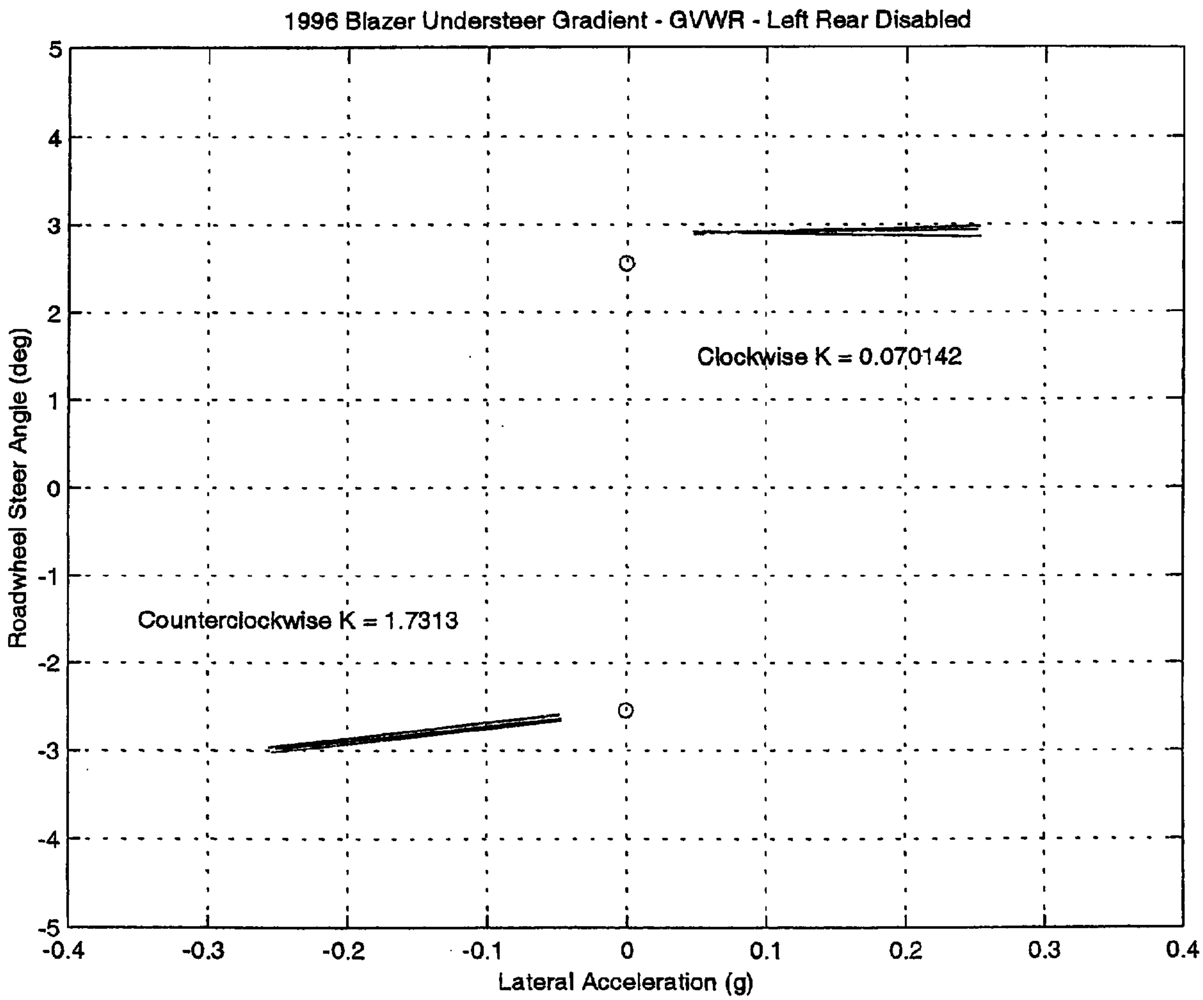


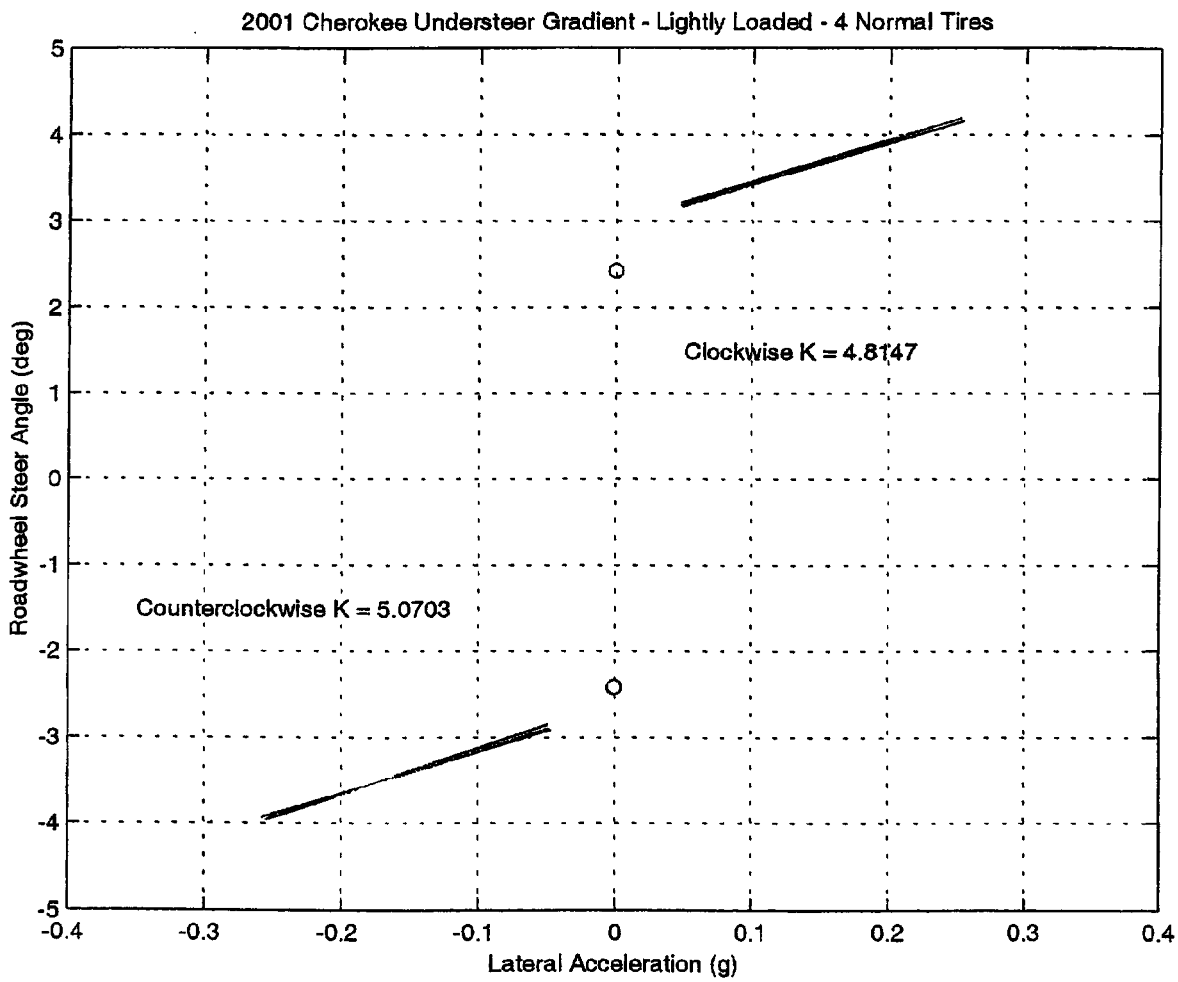
2000 Explorer Understeer Gradient - GVWR - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = -1.5934
Counterclockwise K = -0.85281
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4


1996 Blazer Understeer Gradient - Lightly Loaded - 4 Normal Tires
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 5.1026
Counterclockwise K = 3.4778
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

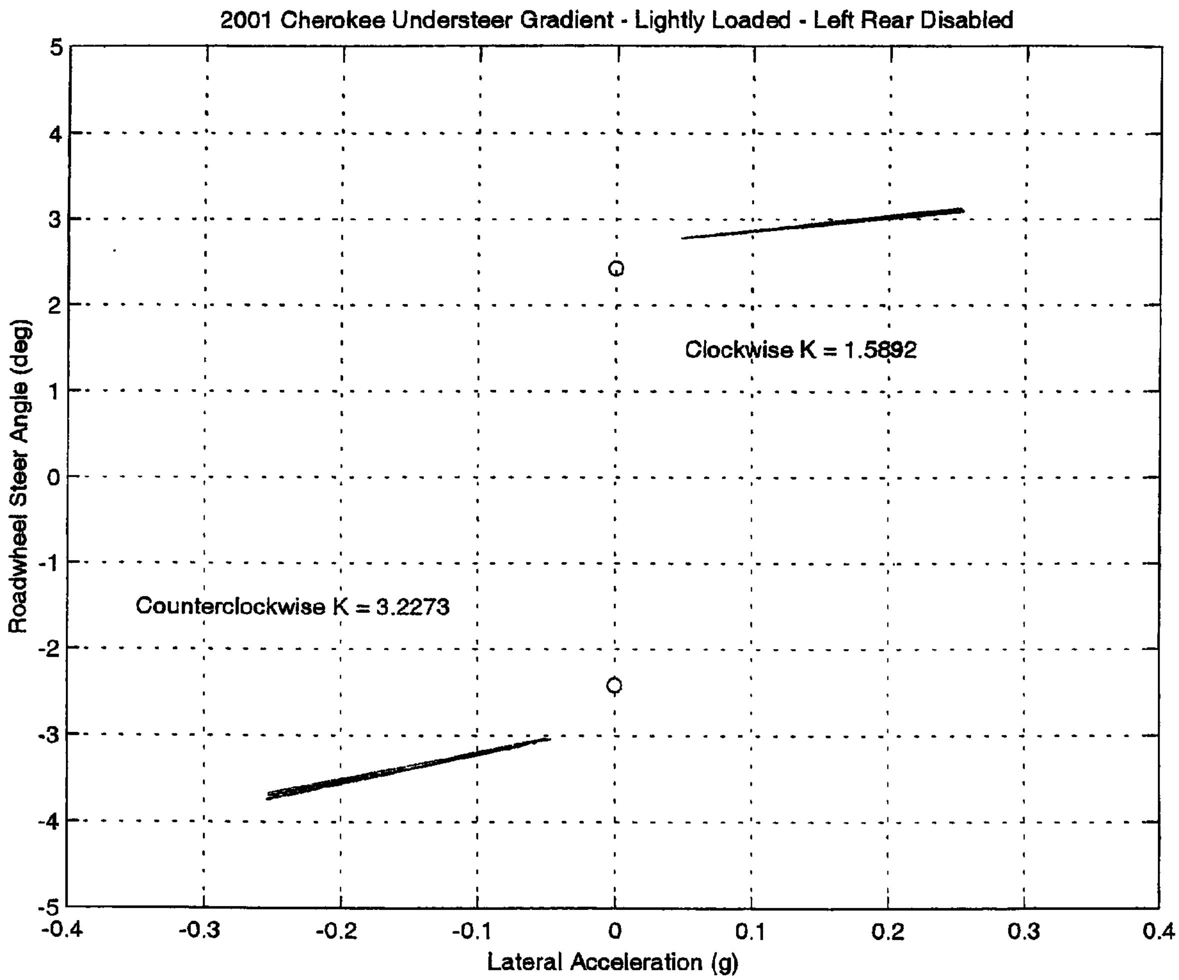

1996 Blazer Understeer Gradient - Lightly Loaded - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 0.47147
Counterclockwise K = 2.9784
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

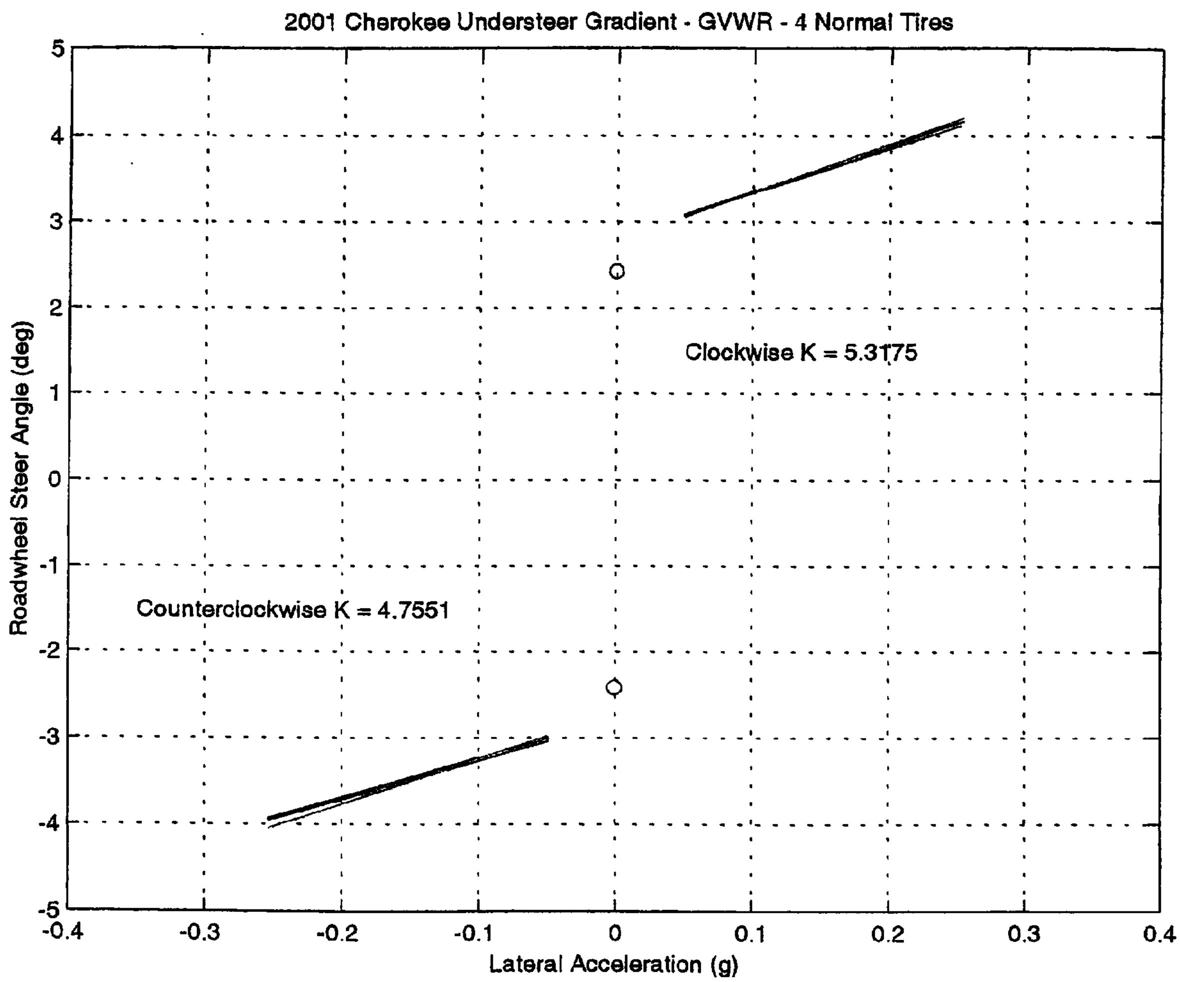

1996 Blazer Understeer Gradient - GVWR - 4 Normal Tires
Clockwise K = 3.8787
Counterclockwise K = 4.6993
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

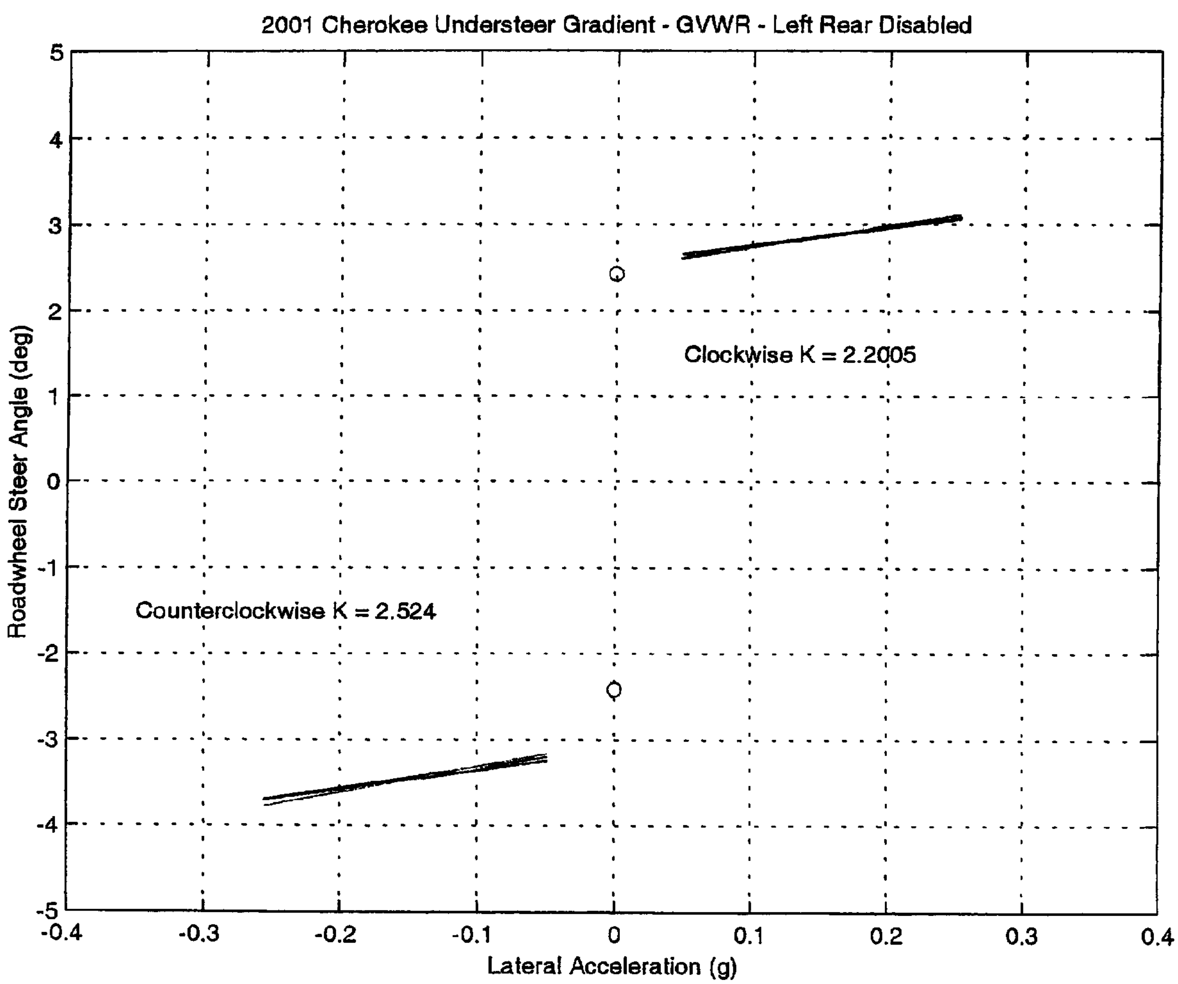

1996 Blazer Understeer Gradient - GVWR - Left Rear Disabled
Roadwheel Steer Angle (deg)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
Lateral Acceleration (g)
Clockwise K = 0.070142
Counterclockwise K = 1.7313



2001 Cherokee Understeer Gradient - Lightly Loaded - 4 Normal Tires
Clockwise K = 4.8147
Counterclockwise K = 5.0703
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4


2001 Cherokee Understeer Gradient - Lightly Loaded - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 1.5892
Counterclockwise K = 3.2273
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4


2001 Cherokee Understeer Gradient - GVWR - 4 Normal Tires
Clockwise K = 5.3175
Counterclockwise K = 4.7551
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4



2001 Cherokee Understeer Gradient - GVWR - Left Rear Disabled
Roadwheel Steer Angle (deg)
Lateral Acceleration (g)
Clockwise K = 2.2005
Counterclockwise K = 2.524
5
4
3
2
1
0
-1
-2
-3
-4
-5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4

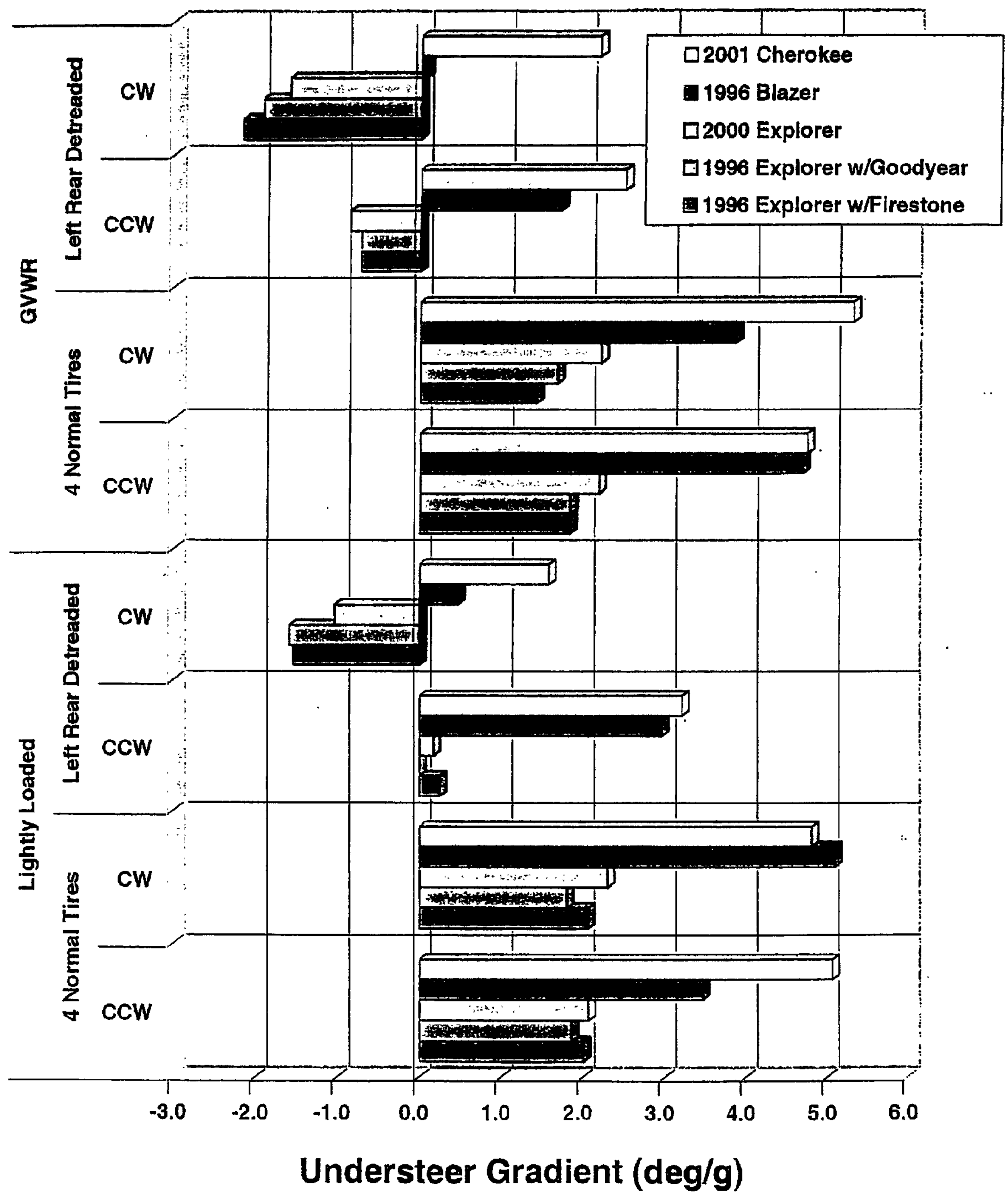
Attachment 7

Conclusions Of Ford's Analysis Of Explorer Controllability Following Tread Separation Are:

- Tire deterioration may cause noise and vibration before separation that can serve as a notice to slow down.
- Absent unique factors, an Explorer will not be forced out of control by vehicle factors before, at, or after tread separation.*
- Like all other vehicles, Explorer handling capacity and margin of safety are reduced by tire tread separation.
- The cause of the vehicle handling capacity loss is tire traction loss that cannot be compensated for in vehicle design with current technology.
- Like other SUV's Explorer handling capacity, even with a separated tire, is sufficient to allow a safe stop.

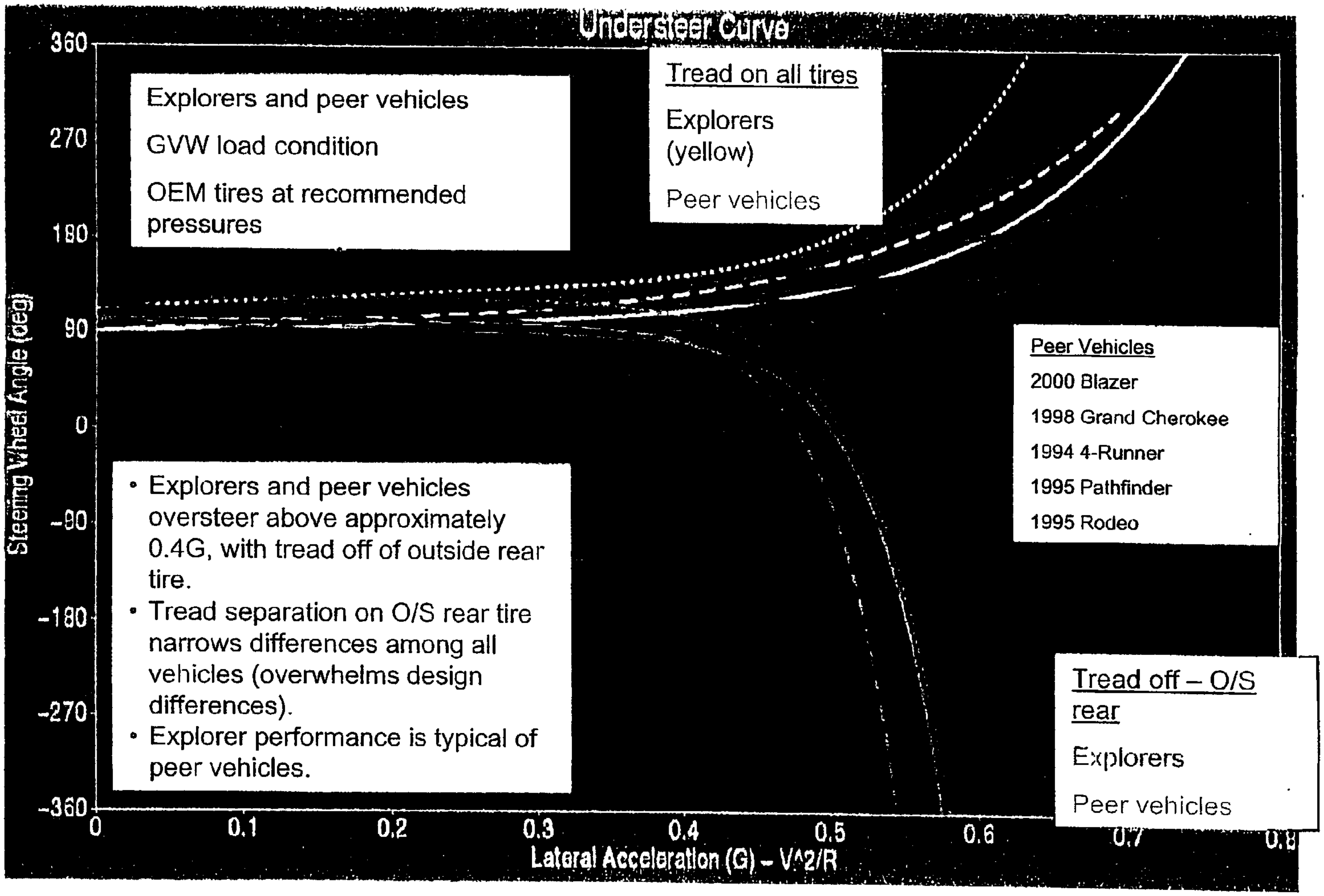
* Unlikely but possible events including interference with wheels and brake parts and including forces associated with partial separation have been discussed earlier in this presentation.

Linear Range Understeer Gradients

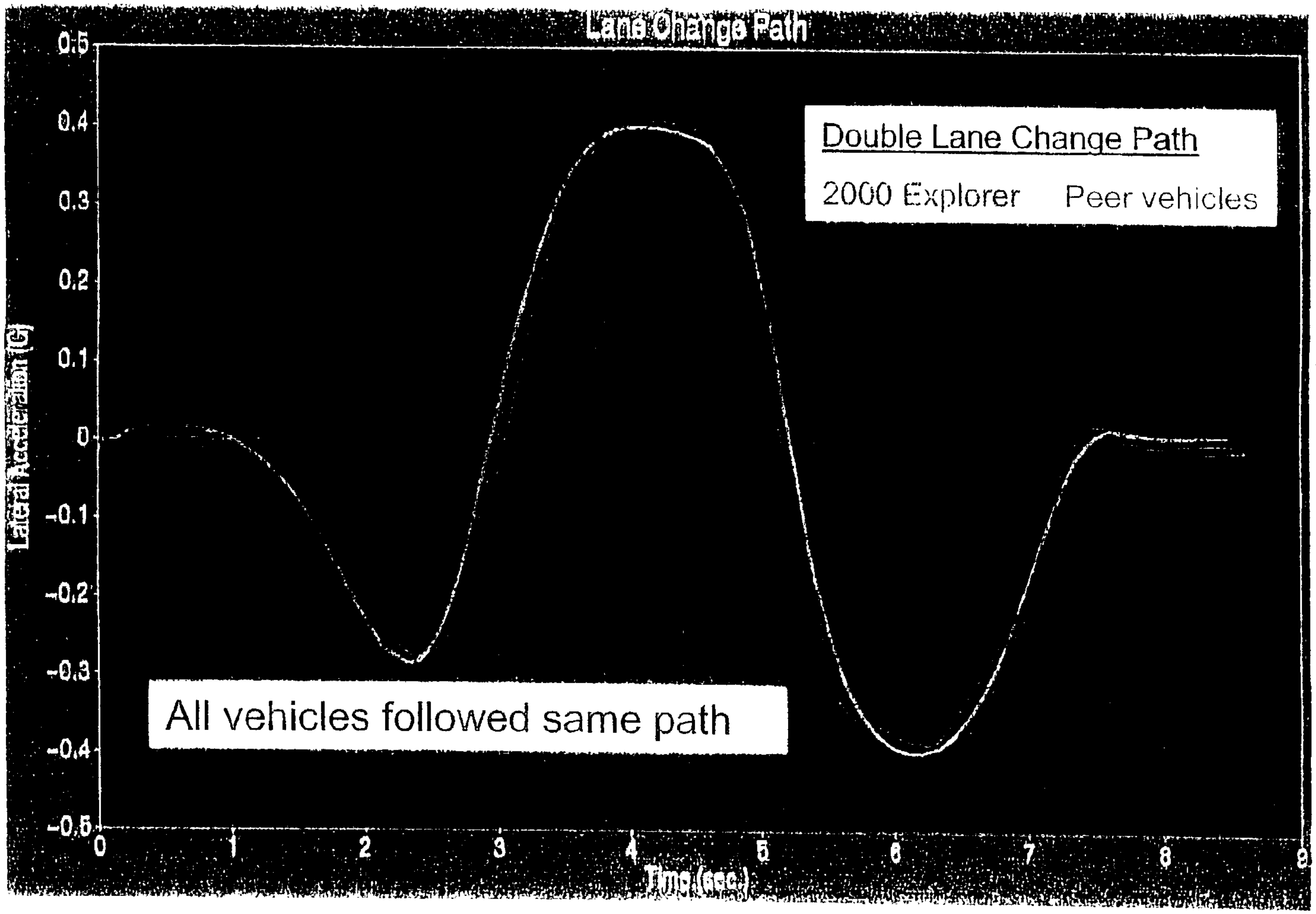


Results – Effect of tread separation

Explorers and Peer vehicles



Results – After tread separation
Full-Vehicle CAE – PCLLC
(all vehicles on Firestone Tires)



Loss Of Control Following Tread Separation Occurs Because Of Basic Physical Principles

Based on case studies, the typical loss of control circumstances are:

- Extreme rotation in a yaw plane
- Yaw rotation in a final turn with separated tire on outside rear
- This common yaw pattern is seen for all vehicle types
  - Passenger cars and light trucks
  - Front wheel drive, rear wheel drive, and all wheel drive
  - Large size and weight, small size and weight
  - No differences among vehicles with various tire brands, type and sizes

The underlying cause of loss of control is that tire traction decreases so that forces and moments cannot be balanced for some steering demands. This fundamental cause overwhelms differences in design among vehicle classes or within vehicle classes. Explorers perform like all other vehicles.

Chart #10

Explorer GVW Changes by Year

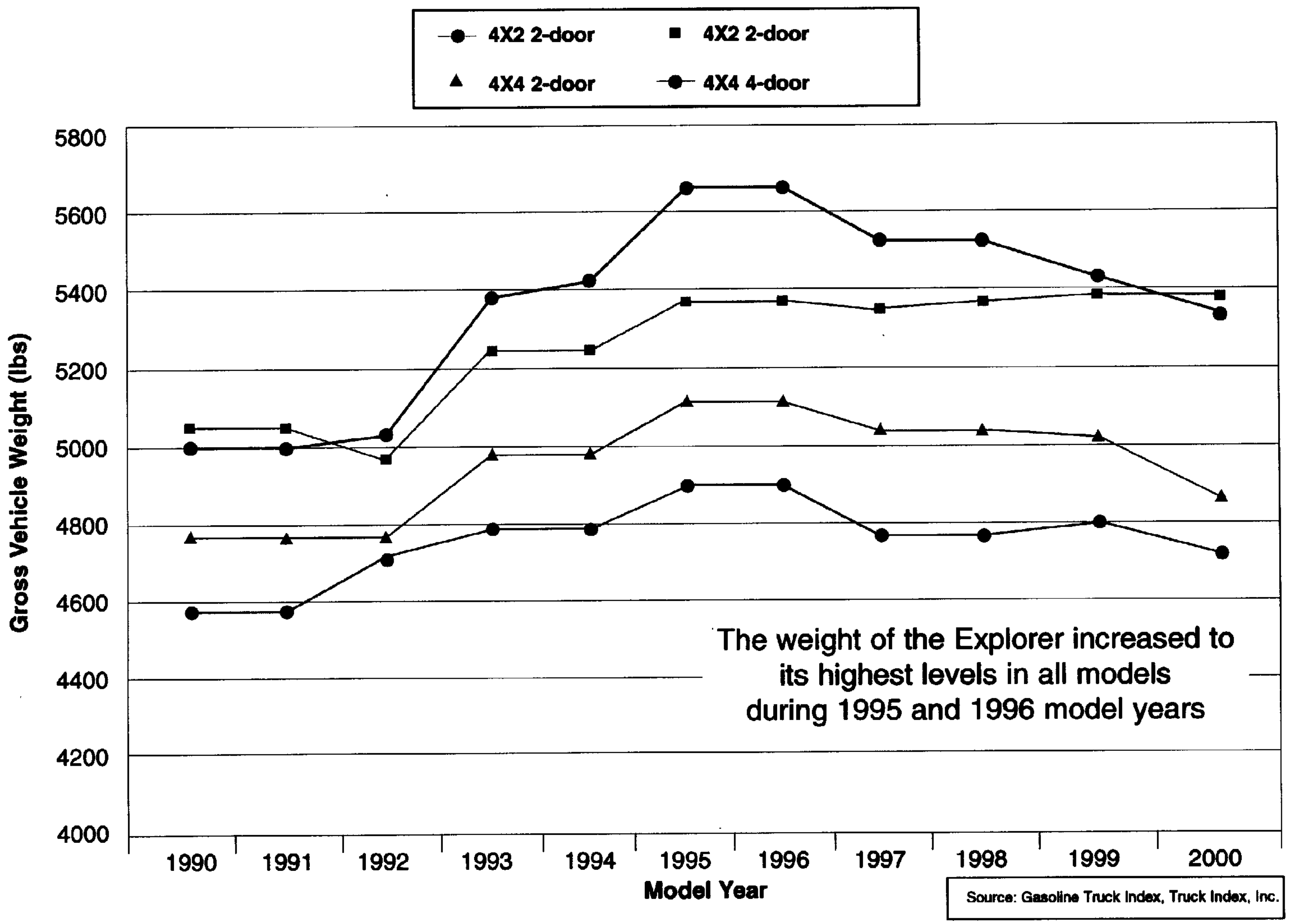
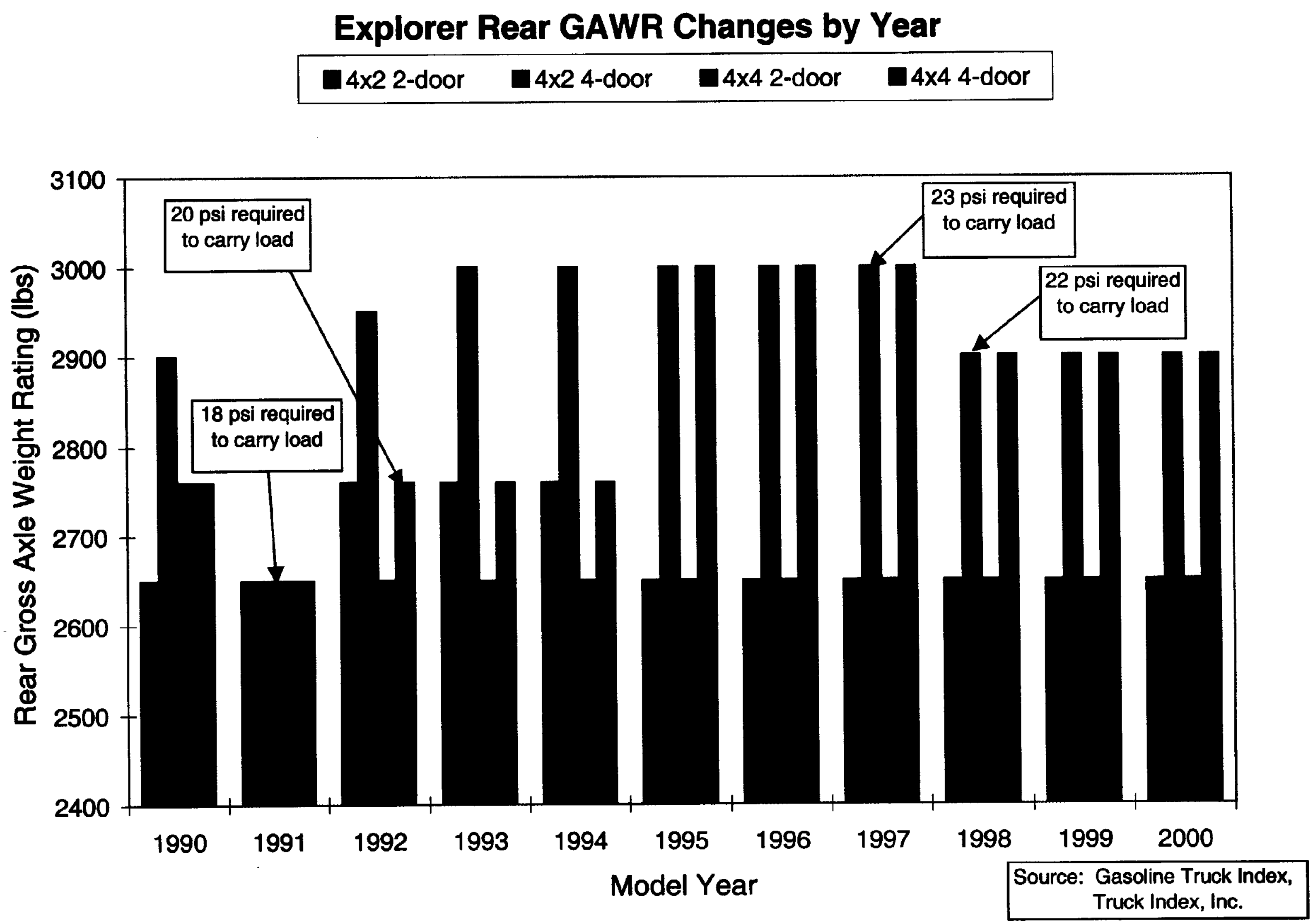


Chart #11



Explorer Rear GAWR Changes by Year
4x2 2-door
4x2 4-door
4x4 2-door
4x4 4-door
Rear Gross Axle Weight Rating (lbs)
3100
3000
2900
2800
2700
2600
2500
2400
20 psi required to carry load
18 psi required to carry load
23 psi required to carry load
22 psi required to carry load
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
Model Year
Source: Gasoline Truck Index, Truck Index, Inc.

Chart #12

Tire Load Capacity - Explorer
98 XLT / Fort Stockton Measurement

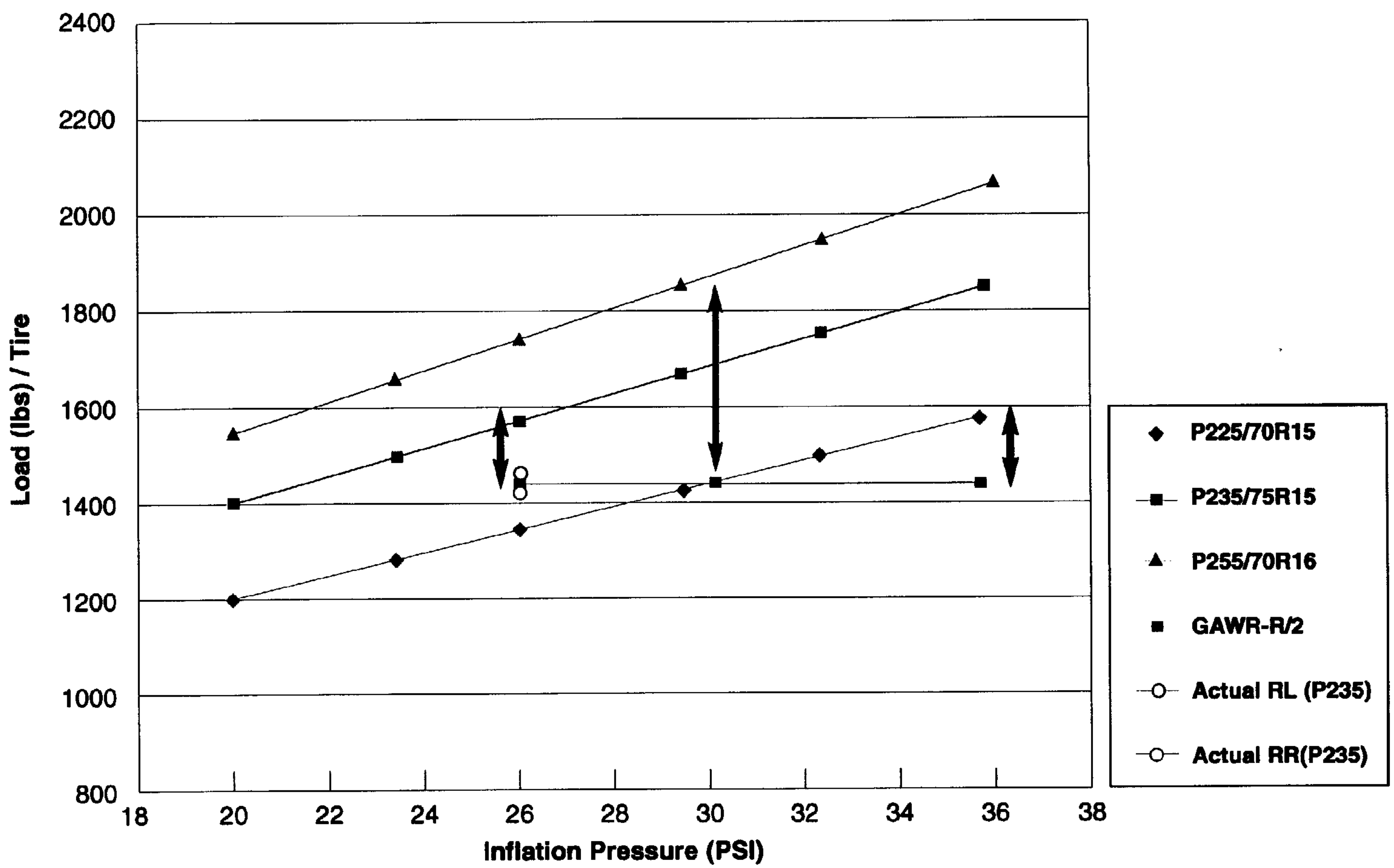


Chart #13

FLORIDA Single Vehicle Highway Tire-Related Rollover Crash Rates by Model Year Accident Years 1993-2000

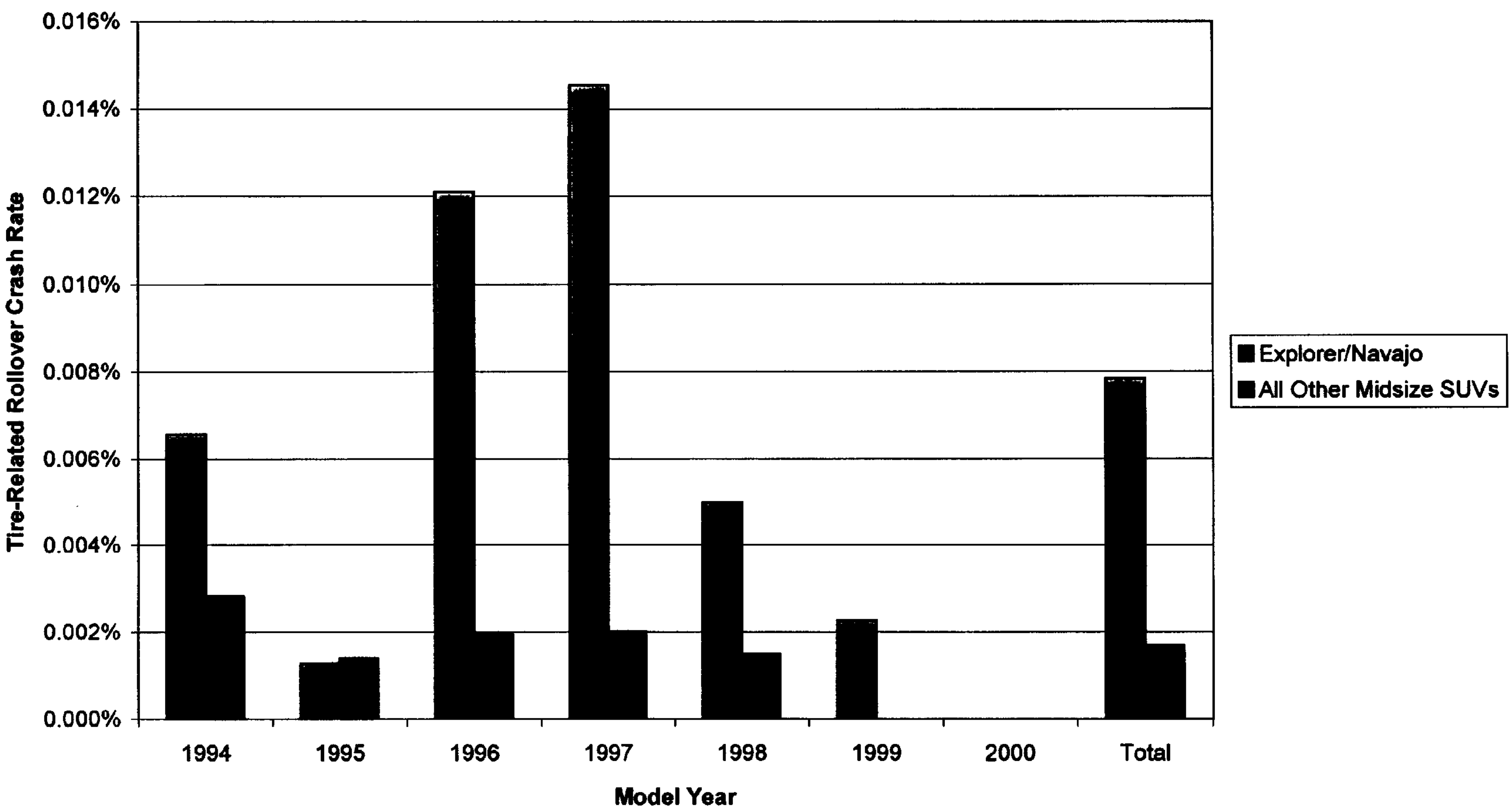


Chart #14

FLORIDA Single Vehicle Highway Fatal Incident Crash Rates by Model Year Accident Years 1993-2000

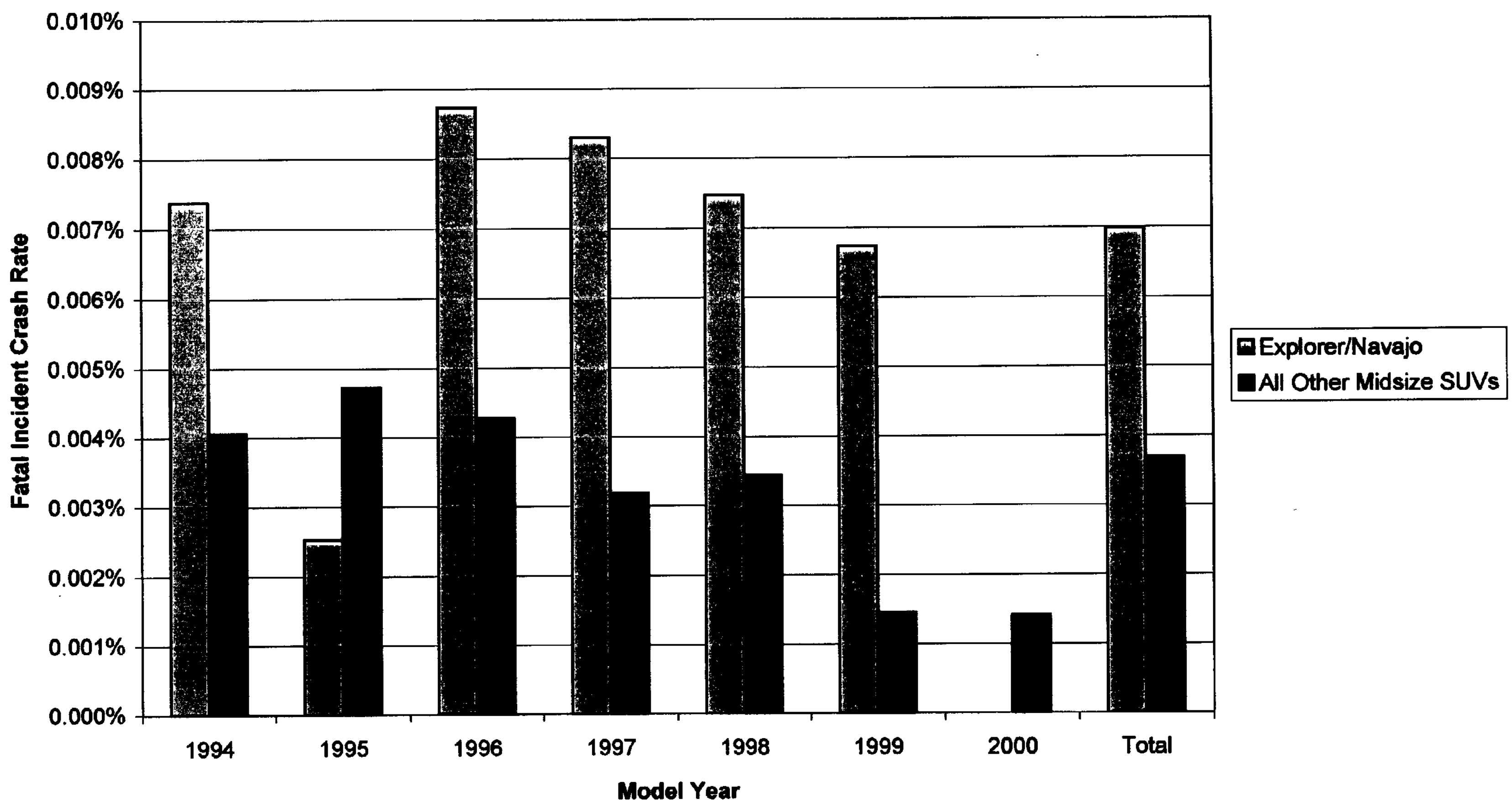
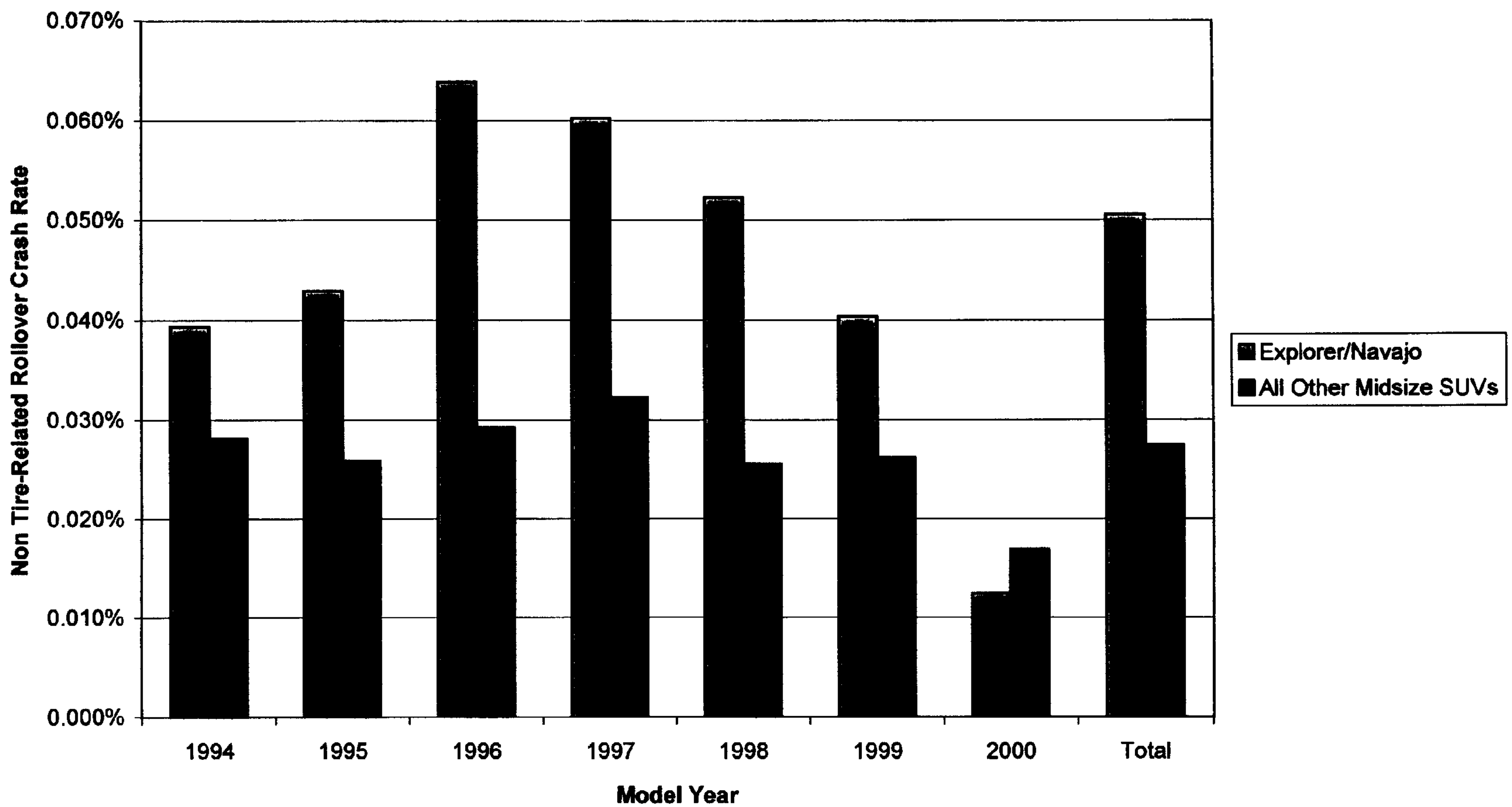


Chart #15

FLORIDA Single Vehicle Highway Non Tire-Related Rollover Crash Rates by Model Year Accident Years 1993-2000



Attachment 5

FLORIDA CRASH, ROLLOVER, AND FATAL ACCIDENT RATES BASED ON VEHICLE REGISTRATIONS

DOCUMENTATION

JUNE 11, 2001

FLORIDA DATABASE OVERVIEW

The analyses in this document are based on the Florida Traffic Crash Database. The Florida Traffic Crash Database contains information on motor vehicle crashes that occurred in the state of Florida in calendar years 1993-1999, and through the first three quarters of 2000. It is organised in seven relational databases containing information on the Event, Vehicle, Driver, Pedestrians, Violations, Passengers and D.O.T Site Location.

Only crashes that required police intervention or the provision of emergency services are present in the database, since official reports are only produced if these agencies are involved in the incident. All statistics presented refer only to the population of vehicles involved in the reported incidents, i.e. all statistics are conditional on being in the crash database.

To identify the specific vehicle make and model, a VIN decoder was used. The analyses presented here are based on VIN decoding of the database by Firestone. Firestone utilizes a POLK VIN decoder, a commercially available VIN decoder.

Of the 2,894,366 records in the Florida database that are vehicle type automobile, passenger van, or pickup/light truck (2 rear tires) [Type of Vehicle = 01, 02, or 03], 2,783,084 had 11-digit VIN numbers and were sent to be VIN decoded. Of these 2,783,084 records, 2.1 million records (2,088,901 specifically) were VIN decoded. Of the 111,282 that did not have 11-digit VINs, 20,299 records had between 7 and 10 digits. A minimum of 7 digits is required to identify make and model. Make and model cannot be identified for the other 90,983.

Among the 2,088,901 VIN decoded records, 177,705 are single vehicle crashes. Of these, 19,226 are sport utility vehicle (SUV) crashes and 10,989 are mid size sport utility crashes. Of the 10,989 mid-size SUV crashes on any road, 2,491 are single vehicle mid-size SUV <u>highway</u> crashes. Of these, 202 are tire-related (about 8 percent) and 2,289 (about 92 percent) are non-tire related single vehicle highway crashes.

The analysis presented here examines single-vehicle-highway crash and rollover rates for Ford Explorers, a specific set of SUVs, and other mid-size SUVs for accident years 1993-2000. <u>This analysis is based on crashes that occurred in Florida for vehicles registered in Florida.</u>

POLK REGISTRATION DATA

The vehicle registration numbers for Florida are based on POLK registration data by vehicle make and model by registration year (July 1 of that year) and vehicle-model year. These data were obtained from Firestone. Vehicle registrations are presented by vehicle-model year for the period 1993-2000. For example, a 1994 vehicle could be registered for up to 8 years over the 1993-2000 time period (due to lag between model year and calendar year). If a vehicle is registered in each of those registration years, the vehicle is counted 8 times.

For model year 1994-2000 vehicles registered between 1993 and 2000, the market share for:

- Ford Explorer/Mazda Navajos is 27%, and
- Other Mid-size SUVs is 73%.

Computing Crash and Rollover Rates

To ensure consistency between the Florida crash database and the Polk registration data for computing rates, the results presented in this document are based on single vehicle midsize SUV highway crashes and rollovers for the accident years 1993-2000 and vehicle-model years 1994-2000 for vehicles registered in the state of Florida only. Crashes that occurred in Florida for vehicles registered in other states are not included in this analysis because these vehicles are not counted in the Polk registration data for Florida.

Format of Tables

Results are presented as follows:

- Table 1 presents single vehicle highway crashes;
- Table 2 presents single vehicle highway tire-related crashes;
- Table 3 presents single vehicle highway tire-related rollovers;
- Table 4 presents single vehicle highway non-tire related rollovers;
- Table 5 presents single vehicle highway crash fatalities;
- Table 6 presents single vehicle highway tire-related crash fatalities; and
- Table 7 presents registration by model year (based on Polk data).

Each table has three parts – counts (of crashes, rollovers, etc.), vehicle registrations, and rates (crash/registration, for example).

- **Counts.** The first part of each table shows the number of single vehicle midsize SUV highway crashes or rollovers (this varies by table) for 10 selected SUVs - Chevy Blazer, Jeep Cherokee, Ford Explorer, Mazda Navajo, Toyota 4Runner, Nissan Pathfinder, Isuzu Rodeo, Jeep Grand Cherokee, GMC Jimmy, and Isuzu Trooper. - for the accident years 1993-2000 and for model years 1994-2000 in Florida. A specific comparison between the Ford Explorer/ Mazda Navajo SUV and all other midsize SUVs is also provided.

- **Registrations**. The second part of each table shows the number of registered vehicles in Texas by vehicle-model year for 10 selected SUVs . A specific comparison between the Ford Explorer/Mazda Navajo and all other midsize SUVs is also provided.

- **Rates**. The third part shows the "rates" in Florida by vehicle-model year for the 10 selected SUVs. A specific comparison between the Ford Explorer/Mazda Navajo and all other midsize SUVs is also provided.

VARIABLE DEFINITIONS

- Type of Vehicle – type of vehicle is automobile, passenger van, or pickup/light truck [2 rear tires] (Type of Vehicle = 01, 02, or 03).
- Single Vehicle – number of vehicles involved in the crash is equal to 1 (Total Number of Vehicles).
- Highway – Crash occurred on an Interstate, US Highway, Turnpike/Toll (Road System Identifier = 01, 02, or 06)
- Vehicle Identification Number –11-digit VIN used to identify information about a specific vehicle (e.g., make and model) after decoding.
- Vehicle Make – Digits 1, 2, and 3 from the VIN number identify vehicle manufacturer, make, and type (e.g., Ford Motor Company, Ford, passenger car).
- Vehicle Model – Digits 5, 6, and 7 from the VIN number identify vehicle line and body type (e.g., Taurus GL 4-door sedan).
- Explorer and Navajo – For the Explorer, make is Ford and model is Explorer (all types including XL, XLS, etc.). For the Navajo, make is Mazda and model is Navajo.
- Mid Size SUVs – all SUV makes and models identified in Appendix A for Florida except the Ford Explorer and the Mazda Navajo.
- Tire-related Incident – A tire-related incident is defined as tire puncture/blowout or worn/smooth tires (1st Vehicle Defect = 03 (worn/smooth tires) or 05 (puncture/blowout) OR 2nd Vehicle Defect = 03 or 05).
- Rollover – The first harmful event that took place in the crash is identified as overturned (1st Harmful Event = 31).
- Fatality Incident - The crash injury severity is identified as fatal injury (Crash Injury Severity = 5) or the injury severity of the driver is identified as fatal injury (Injury Severity (Driver) = 5).
- Vehicle Registration – The state of registration (USPS abbreviations for states in capital letters).

RESULTS

Table 1 shows single vehicle highway crash counts, registrations, and crash rates for 10 specific SUVs and also compares crash rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year. The focus of this discussion is on the rates at the bottom on the page.

- When compared one-on-one to other specific SUVs, the Ford Explorer is better than some and worse than some in terms of crash rates.
- When compared to mid-size SUVs as a group, the Ford Explorer/Navajo crash rates are particularly higher in model years 1996 and 1997.
- When compared to itself, the Ford Explorer crash rates are highest in model years 1996 and 1997.

Table 2 shows the single vehicle highway tire-related crash counts, registrations, and crash rates for 10 specific SUVs and also compares tire-related crash rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year. The focus of this discussion is on the rates at the bottom on the page.

- When compared one-on-one to other specific SUVs, the Ford Explorer tire-related crash rates are among the highest in almost every single model year.
- When compared to other mid-size SUVs as a group, the Ford Explorer/Navajo tire-related crash rates are far higher in model years 1996, 1997, and 1998.
- When compared to itself, the Ford Explorer tire-related crash rate is highest in model years 1996 and 1997.

Consistent with the vehicle test results, once a tire problem occurs, the 1996 and 1997 Ford Explorer performs worse than other mid-size SUVs as a group and worse than particular SUVs in one-on-one comparisons.

Table 3 shows the single vehicle highway tire-related rollover counts, registrations, and rollover rates for 10 specific SUVs and also compares tire-related rollover rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year. The focus of this discussion is on the rates at the bottom on the page.

- When compared one-on-one to other SUVs, the Ford Explorer is worse than each of the other SUVs (except the 4Runner in 1996) in terms of tire-related rollover rates in model years 1996 and 1997.

- When compared to other mid-size SUVs as a group, the Ford Explorer/Navajo tire-related rollover rates are far higher in model years 1996, 1997, and 1998.

- When compared to itself, the Ford Explorer tire-related crash rate is highest in model years 1996 and 1997.

Consistent with the vehicle test results, once a tire problem occurs, specific Ford Explorer model years (in this case, the 1996 and 1997 Ford Explorers) perform far worse than other mid-size SUVs as a group and in most one-on-one comparisons.

Table 4 shows the single vehicle highway non-tire related rollover counts, registrations, and rollover rates for 10 specific SUVs and also compares non-tire related rollover rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year. The focus of this discussion is on the rates at the bottom on the page.

- When compared one-on-one to other SUVs, the Ford Explorer is either the worst performer or among the worst in terms of rollover rates.

- When compared to other mid-size SUVs as a group, the Ford Explorer/Navajo non-tire related rollover rates are about twice as high in model years 1995, 1996, 1997, and 1998.

- When compared to itself, the Ford Explorer non- tire related rollover rate is highest in model years 1996 and 1997.

Hence, when a tire-related problem does not occur, the Ford Explorer is a worse performer than other midsize SUVs in terms of rollover rates.

Table 5 shows the single vehicle highway fatal accident counts, registrations, and fatal accident rates for 10 specific SUVs and also compares fatal accident rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year.

- When compared one-on-one to other SUVs, the Ford Explorer is better than some and worse than some in terms of fatal accident rates.

- When compared to other mid-size SUVs as a group, the Ford Explorer/Navajo fatal accident rates are more than twice as high in model years 1996, 1997, and 1998.

- When compared to itself, the Ford Explorer fatal accident rate is highest in model years 1994, 1996, and 1997.

Table 6 shows the single vehicle highway tire-related fatal accident counts, registrations, and fatal accident rates for 10 specific SUVs and also compares tire-related fatal accident rates between the Ford Explorer/Navajo and all other midsize SUVs in Florida by model year. The numbers are very small for this analysis.

- When compared one-on-one to other SUVs, the Ford Explorer is typically the worst performer in terms of tire-related fatal accident rates.
- When compared to other mid-size SUVs as a group, tire-related fatal accidents only occurred on Ford Explorers in 1996, 1997, and 1998.
- When compared to itself, the Ford Explorer fatal accident rate is highest in model years 1994, 1996, and 1997.

Table 7 presents the Polk registration data by vehicle model year. Among mid-size SUVs for model years 1994-2000, Ford Explorer/Mazda Navajos comprise about 27% of the market share.

Appendix A

MID-SIZE SUV REFERENCE LIST AND SUVS IDENTIFIED IN FLORIDA CRASH DATABASE (IF MIDSIZE LIST = 1)

THE Mid-Size SUV LIST

Make	Model	X if SUV is in Florida Crash database	X if SUV is in Texas Crash database	JD Power Market Segment	Gross Weight (Min)	Gross Weight (Max)	Midsize List
AM General	Hummer H3			Midsize	NA	NA	
Buick	Rendezvous			Midsize	NA	NA	
Chevrolet	Blazer	X	X	Midsize	4450	5300	1
Chevrolet	S-10 Blazer	X	X	Midsize	4350	5100	1
Chevrolet	Trailblazer			Midsize	NA	NA	
Chrysler	Citadel			Midsize	NA	NA	
Dodge	Durango	X		Midsize	6050	6400	
Ford	CrossTrainer Wagon			Midsize	NA	NA	
Ford	Explorer	X	X	Midsize	4760	5560	1
Ford	Ranger SUV			Midsize	4420	5120	1
GMC	Envoy			Midsize	NA	NA	
GMC	Jimmy	X	X	Midsize	4450	5300	1
GMC	Jimmy Sonoma	X	X	Midsize	4450	5300	1
GMC	Jimmy/Envoy	X		Midsize	4450	5300	1
Honda	MAV			Midsize	NA	NA	
Honda	Passport	X	X	Midsize	3958	3958	1
Isuzu	Axiom			Midsize	3920	4180	1
Isuzu	Rodeo	X	X	Midsize	4550	4900	1
Isuzu	Rodeo/Rodeo Sport	X		Midsize	4550	4700	1
Isuzu	Trooper	X	X	Midsize	.5350.	5550	1
Isuzu	Trooper II	X	X	Midsize	5510	5510	1
Isuzu	VehiCROSS	X		Midsize	4852	4852	1
Jeep	Grand Cherokee	X	X	Midsize	4950	5600	1
Land Rover	Discovery	X	X	Midsize	4465	4576	1
Mazda	Navajo	X	X	Midsize	3785	4184	1
Mazda	Nextourer			Midsize	NA	NA	
Mercury	Mountaineer	X	X	Midsize	4780	5560	1
Mitsubishi	Montero	X	X	Midsize	5732	5732	1
Mitsubishi	Montero Sport	X	X	Midsize	4730	5000	1
Nissan	Pathfinder	X	X	Midsize	3980	4075	1
Oldsmobile	Bravada	X	X	Midsize	4049	5300	1
Subaru	Lambda SUV			Midsize	NA	NA	
Toyota	4-Runner	X	X	Midsize	5250	5400	1
Toyota	Highlander			Midsize	4982	4982	1
Volkswagen	SUV			Midsize	NA	NA	
Acura	MDX			Luxury	5690	5690	1
Acura	SLX	X	X	Luxury	4315	4315	1
AM General	Hummer			Luxury	NA	NA	
BMW	X3			Luxury	NA	NA	
BMW	X5	X		Luxury	4795	4795	1
BMW	X7			Luxury	NA	NA	
Cadillac	Crossover			Luxury	NA	NA	

Cadillac	Escalade	X		Luxury	5572	5572	
Cadillac	LAV			Luxury	NA	NA	
Infiniti	Crossover			Luxury	NA	NA	
Infiniti	Fullsize SUV			Luxury	NA	NA	
Infiniti	QX4	X	X	Luxury	4275	4275	1
Land Rover	DiscoverySeriesII	X	X	Luxury	4576	4630	1
Land Rover	Range Rover	X	X	Luxury	4828	4828	1
Lexus	LX 450	X	X	Luxury	4751	4751	1
Lexus	LX 470	X		Luxury	5401	5401	
Lexus	RX300	X		Luxury	3789	3925	
Lincoln	Compact SUV			Luxury	NA	NA	
Lincoln	LAV			Luxury	NA	NA	
Lincoln	Navigator	X		Luxury	6750	7200	
Mercedes Benz	Crossover SUV			Luxury	NA	NA	
Mercedes Benz	M-Class			Luxury	NA	NA	
Mercedes Benz	ML-Class (ML320)	X		Luxury	NA	NA	
Mercedes Benz	MLG			Luxury	NA	NA	
Porsche	Cayenne			Luxury	NA	NA	
Saab	SUV			Luxury	NA	NA	
Toyota	LandCruiser	X	X	Luxury	6470	6860	
Volvo	SUV			Luxury	NA	NA	
AM General	Hummer H2			Fullsize	6964	6964	
Chevrolet	Suburban	X	X	Fullsize	6800	8600	
Chevrolet	Tahoe	X	X	Fullsize	6100	6800	
Ford	Bronco	X	X	Fullsize	6000	6450	
Ford	Excursion	X		Fullsize	8800	9200	
Ford	Expedition	X	X	Fullsize	6700	7200	
GMC	Denali	X		Fullsize	5583	5583	
GMC	Suburban	X	X	Fullsize	6800	8600	
GMC	Typhoon	X		Fullsize	4700	4700	1
GMC	Yukon	X	X	Fullsize	6800	6800	
GMC	Yukon Denali	X	X	Fullsize	6800	6800	
GMC	Yukon XL	X	X	Fullsize	6800	6800	
GMC	Yukon XL Denali	X	X	Fullsize	6800	6800	
Nissan	Fullsize SUV			Fullsize	NA	NA	
Toyota	Sequoia			Fullsize	6500	6600	
Chevrolet	Tracker	X		Entry	3080	3924	
Chevrolet	Traverse			Entry	NA	NA	
Chrysler	Korando			Entry	NA	NA	
Chrysler	Musso			Entry	NA	NA	
Ford	Escape			Entry	4100	4570	1
Geo	Tracker	X	X	Entry	2189	2189	
Honda	CR-V		X	Entry	3164	3164	
Hyundai	Santa Fe			Entry	4950	5240	
Isuzu	Amigo	X	X	Entry	4100	4500	1
Jeep	Cherokee	X	X	Entry	4550	4900	1
Jeep	Liberty			Entry	NA	NA	
Jeep	Varsity			Entry	NA	NA	

Jeep	Wrangler	X	X	Entry	4300	4450	1
Kia	Sportage	X	X	Entry	4296	5896	1
Land Rover	Defender	X	X	Entry	3600	3600	
Land Rover	Freelander			Entry	NA	NA	
Mazda	Tribute			Entry	NA	NA	
Mitsubishi	Dingo			Entry	NA	NA	
Nissan	Crossover			Entry	NA	NA	
Nissan	Xterra	X		Entry	3504	3858	
Pontiac	Aztek			Entry	NA	NA	
Saturn	VUE			Entry	NA	NA	
Subaru	Forester	X		Entry	3125	3125	
Suzuki	Grand Vitara	X		Entry	3375	3500	
Suzuki	Samurai	X	X	Entry	2870	2932	
Suzuki	Sidekick	X	X	Entry	3086	3682	
Suzuki	Vitara	X		Entry	2875	3375	
Suzuki	X90	X	X	Entry	2734	2954	
Suzuki	XL7			Entry	NA	NA	
Toyota	Rav4	X	X	Entry	3550	3948	

Table 1
Florida-Midsize SUVs, Single Vehicle Highway Crashes (Accident Years 1993-2000)

Model	Single Vehicle Highway Crashes for Florida-Registered Vehicles (By Model Year) 1994	1995	1996	1997	1998	1999	2000	Total
Blazer	20	26	12	12	14	7	7	98
Cherokee	27	17	27	7	3	7	0	88
Explorer	86	57	181	105	70	29	6	534
Navajo	2	0	0	0	0	0	0	2
4Runner	22	19	29	45	19	11	1	146
Pathfinder	17	24	12	11	4	5	0	73
Rodeo	18	20	10	11	10	4	1	74
Grand Cherokee	26	20	19	17	8	3	3	96
GMC Jimmy	8	13	16	7	5	2	1	52
Isuzu Trooper	9	0	1	1	1	1	0	13
Explorer/Navajo	88	57	181	105	70	29	6	536
All Other Midsize SUVS	169	170	137	154	89	54	16	789

Florida	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data 1994	1995	1996	1997	1998	1999	2000	Total
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All Other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

Model	Crash Rates in Florida by Vehicle Type & Model Year (#Crashes/#Registered) 1994	1995	1996	1997	1998	1999	2000	Total
Blazer	0.04%	0.05%	0.03%	0.05%	0.05%	0.04%	0.05%	0.04%
Cherokee	0.05%	0.04%	0.06%	0.06%	0.02%	0.06%	0.00%	0.04%
Explorer	0.07%	0.07%	0.12%	0.11%	0.09%	0.07%	0.04%	0.09%
Navajo	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%
4Runner	0.08%	0.05%	0.11%	0.12%	0.07%	0.06%	0.01%	0.08%
Pathfinder	0.08%	0.07%	0.08%	0.07%	0.04%	0.06%	0.00%	0.07%
Rodeo	0.06%	0.04%	0.05%	0.06%	0.06%	0.03%	0.03%	0.05%
Grand Cherokee	0.04%	0.03%	0.03%	0.03%	0.02%	0.01%	0.02%	0.03%
GMC Jimmy	0.04%	0.06%	0.09%	0.05%	0.05%	0.04%	0.02%	0.06%
Isuzu Trooper	0.08%	0.00%	0.02%	0.06%	0.04%	0.05%	0.00%	0.04%
Explorer/Navajo	0.07%	0.07%	0.12%	0.11%	0.09%	0.07%	0.04%	0.09%
All Other Midsize SUVs	0.05%	0.05%	0.05%	0.06%	0.04%	0.04%	0.02%	0.05%

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Table 2
Florida - Midsize SUVs, Single Vehicle Highway, Tire Related Crashes
(Accident Years 1993 - 2000)

	Single Vehicle Highway Tire Related Crashes for Florida-Registered Vehicles (By Model Year)							
Model	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	1	0	1	0	0	0	1	3
Cherokee	2	0	0	0	0	0	0	2
Explorer	11	2	20	16	5	1	0	55
Navajo	0	0	0	0	0	0	0	0
4Runner	4	1	4	1	0	0	0	10
Pathfinder	5	1	0	3	0	0	0	9
Rodeo	2	0	0	0	2	0	0	4
Grand Cherokee	0	0	0	3	0	1	0	4
GMC Jimmy	0	2	1	0	0	0	0	3
Isuzu Trooper	0	0	0	0	0	0	0	0
Explorer/Navajo	11	2	20	16	5	1	0	55
All Other Midsize SUVs	15	7	7	8	3	2	1	43

	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data							
Florida	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All Other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

	Tire Related Crash Rates in Florida by Vehicle Type & Model Year (#Tire Related Crashes/#Registered)							
Model	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	0.002%	0.000%	0.002%	0.000%	0.000%	0.000%	0.008%	0.001%
Cherokee	0.004%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Explorer	0.009%	0.003%	0.013%	0.017%	0.006%	0.002%	0.000%	0.009%
Navajo	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
4Runner	0.014%	0.003%	0.016%	0.003%	0.000%	0.000%	0.000%	0.006%
Pathfinder	0.024%	0.003%	0.000%	0.019%	0.000%	0.000%	0.000%	0.008%
Rodeo	0.007%	0.000%	0.000%	0.000%	0.011%	0.000%	0.000%	0.003%
Grand Cherokee	0.000%	0.000%	0.000%	0.006%	0.000%	0.004%	0.000%	0.001%
GMC Jimmy	0.000%	0.009%	0.006%	0.000%	0.000%	0.000%	0.000%	0.003%
Isuzu Trooper	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Explorer/Navajo	0.009%	0.003%	0.013%	0.017%	0.006%	0.002%	0.000%	0.009%
All Other Midsize SUVs	0.005%	0.002%	0.003%	0.003%	0.001%	0.001%	0.001%	0.003%

Table 3
Florida - Midsize SUVs, Single Vehicle Highway, Tire Related Rollovers
(Accident Years 1993 - 2000)

	Single Vehicle Highway Tire Related Rollovers for Florida-Registered Vehicles (By Model Year)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	1	0	0	0	0	0	0	1
Cherokee	0	0	0	0	0	0	0	0
Explorer	8	1	18	14	4	1	0	46
Navajo	0	0	0	0	0	0	0	0
4Runner	2	1	3	1	0	0	0	7
Pathfinder	3	0	0	2	0	0	0	5
Rodeo	2	0	0	0	2	0	0	4
Grand Cherokee	0	0	0	2	0	0	0	2
GMC Jimmy	0	2	1	0	0	0	0	3
Isuzu Trooper	0	0	0	0	0	0	0	0
Explorer/Navajo	8	1	18	14	4	1	0	46
All Other Midsize SUVs	9	5	5	5	3	0	0	27

	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data							
Florida	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

	Tire Related Rollover Rates in Florida by Vehicle Type & Model Year (#Tire Related Rollovers/#Registered)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	0.002%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Cherokee	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Explorer	0.007%	0.001%	0.012%	0.015%	0.005%	0.002%	0.000%	0.008%
Navajo	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
4Runner	0.007%	0.003%	0.012%	0.003%	0.000%	0.000%	0.000%	0.004%
Pathfinder	0.014%	0.000%	0.000%	0.013%	0.000%	0.000%	0.000%	0.005%
Rodeo	0.007%	0.000%	0.000%	0.000%	0.011%	0.000%	0.000%	0.003%
Grand Cherokee	0.000%	0.000%	0.000%	0.004%	0.000%	0.000%	0.000%	0.001%
GMC Jimmy	0.000%	0.009%	0.006%	0.000%	0.000%	0.000%	0.000%	0.003%
Isuzu Trooper	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Explorer/Navajo	0.007%	0.001%	0.012%	0.015%	0.005%	0.002%	0.000%	0.008%
All Other Midsize SUVs	0.003%	0.001%	0.002%	0.002%	0.001%	0.000%	0.000%	0.002%

Table 4
Florida - Midsize SUVs, Single Vehicle Highway, Non-Tire Related Rollovers
(Accident Years 1993 - 2000)

	Single Vehicle Highway Non-Tire Related Rollovers for Florida-Registered Vehicles (By Model Year)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	12	15	7	5	10	5	6	60
Cherokee	12	7	14	5	1	3	0	42
Explorer	47	34	95	58	42	18	2	296
Navajo	1	0	0	0	0	0	0	1
4Runner	13	9	15	24	12	8	1	1
Pathfinder	8	14	5	4	2	3	0	36
Rodeo	8	14	6	6	3	4	0	41
Grand Cherokee	13	10	10	9	5	1	2	50
GMC Jimmy	5	7	9	4	4	1	1	31
Isuzu Trooper	6	0	1	0	1	0	0	8
Explorer/Navajo	48	34	95	58	42	18	2	297
All other midsize SUVs	90	93	75	81	52	36	12	439

	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data							
Florida	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All other Midsize SUVS	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

	Non- Tire Related Rollover Rates in Florida by Vehicle Type & Model Year (#Non-Tire Related Rollovers/#Registered)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	0.027%	0.031%	0.017%	0.019%	0.035%	0.032%	0.046%	0.027%
Cherokee	0.021%	0.014%	0.031%	0.041%	0.006%	0.025%	0.000%	0.021%
Explorer	0.040%	0.043%	0.064%	0.060%	0.052%	0.040%	0.012%	0.051%
Navajo	0.033%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.033%
4Runner	0.047%	0.024%	0.059%	0.064%	0.045%	0.046%	0.014%	0.001%
Pathfinder	0.038%	0.043%	0.034%	0.026%	0.018%	0.035%	0.000%	0.034%
Rodeo	0.026%	0.030%	0.033%	0.031%	0.017%	0.030%	0.000%	0.028%
Grand Cherokee	0.019%	0.015%	0.016%	0.017%	0.014%	0.004%	0.013%	0.016%
GMC Jimmy	0.027%	0.032%	0.050%	0.031%	0.042%	0.019%	0.021%	0.034%
Isuzu Trooper	0.056%	0.000%	0.018%	0.000%	0.039%	0.000%	0.000%	0.026%
Explorer/Navajo	0.039%	0.043%	0.064%	0.060%	0.052%	0.040%	0.012%	0.051%
All other Midsize SUVs	0.028%	0.026%	0.029%	0.032%	0.026%	0.026%	0.017%	0.027%

Table 5
Florida - Midsize SUVs, Single Vehicle Highway, Fatal Accidents (Acc. Yrs 1993-2000)

	Single Vehicle Highway Fatal Accidents for Florida-Registered Vehicles (By Model Year)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	1	4	1	1	5	0	1	13
Cherokee	2	2	2	0	0	0	0	6
Explorer	9	2	13	8	6	3	0	41
Navajo	0	0	0	0	0	0	0	0
4Runner	2	3	1	2	1	0	0	9
Pathfinder	1	1	1	0	0	0	0	3
Rodeo	3	3	2	0	0	0	0	8
Grand Cherokee	0	1	2	0	0	0	0	3
GMC Jimmy	3	1	0	1	1	0	0	6
Isuzu Trooper	1	0	1	0	0	0	0	2
Explorer/Navajo	9	2	13	8	6	3	0	41
All Other Midsize SUVs	13	17	11	8	7	2	1	59

	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data							
Florida	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All Other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

	Fatal Accident Rates in Florida by Vehicle Type and Model Year (#Fatalities/#Registered)							
Model	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**Total**
Blazer	0.002%	0.008%	0.002%	0.004%	0.017%	0.000%	0.008%	0.006%
Cherokee	0.004%	0.004%	0.004%	0.000%	0.000%	0.000%	0.000%	0.003%
Explorer	0.008%	0.003%	0.009%	0.008%	0.007%	0.007%	0.000%	0.007%
Navajo	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
4Runner	0.007%	0.008%	0.004%	0.005%	0.004%	0.000%	0.000%	0.005%
Pathfinder	0.005%	0.003%	0.007%	0.000%	0.000%	0.000%	0.000%	0.003%
Rodeo	0.010%	0.007%	0.011%	0.000%	0.000%	0.000%	0.000%	0.005%
Grand Cherokee	0.000%	0.002%	0.003%	0.000%	0.000%	0.000%	0.000%	0.001%
GMC Jimmy	0.016%	0.005%	0.000%	0.008%	0.011%	0.000%	0.000%	0.007%
Isuzu Trooper	0.009%	0.000%	0.018%	0.000%	0.000%	0.000%	0.000%	0.007%
Explorer/Navajo	0.007%	0.003%	0.009%	0.008%	0.007%	0.007%	0.000%	0.007%
All Other Midsize SUVs	0.004%	0.005%	0.004%	0.003%	0.003%	0.001%	0.001%	0.004%

Table 6

Florida - Midsize SUVs, Single Vehicle Highway, Tire Related Fatal Accidents

(Accident Years 1993 - 2000)

Model	Single Vehicle Highway Tire Related Fatal Accidents for Florida-Registered Vehicles (By Model Year)							
	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	0	0	0	0	0	0	0	0
Cherokee	0	0	0	0	0	0	0	0
Explorer	2	0	5	3	3	0	0	13
Navajo	0	0	0	0	0	0	0	0
4Runner	0	0	0	0	0	0	0	0
Pathfinder	0	0	0	0	0	0	0	0
Rodeo	1	0	0	0	0	0	0	1
Grand Cherokee	0	0	0	0	0	0	0	0
GMC Jimmy	0	1	0	0	0	0	0	1
Isuzu Trooper	0	0	0	0	0	0	0	0
Explorer/Navajo	2	0	5	3	3	0	0	13
All Other Midsize SUVs	1	2	0	0	0	0	0	3

Florida	Number of Registered Vehicles between 1993-2000 for Selected SUVs (by Model Year) - Polk Data							
	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172	219,040
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465	197,399
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036	583,919
Navajo	3,022	-	-	-	-	-	-	3,022
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970	178,285
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987	106,481
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161	148,265
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954	321,660
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707	90,427
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470	30,591

	Number of Registered Vehicles between 1993-2000 for Explorer/Navajos and other Midsize SUVs (by Model Year) - Polk Data							
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036	586,941
All other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966	1,599,754
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002	2,186,695

Model	Tire Related Fatal Accident Rates in Florida by Vehicle Type & Model Year (#Tire Related Fatalities/#Registered)							
	1994	1995	1996	1997	1998	1999	2000	Total
Blazer	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Cherokee	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Explorer	0.002%	0.000%	0.003%	0.003%	0.004%	0.000%	0.000%	0.002%
Navajo	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
4Runner	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Pathfinder	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Rodeo	0.003%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Grand Cherokee	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
GMC Jimmy	0.000%	0.005%	0.000%	0.000%	0.000%	0.000%	0.000%	0.001%
Isuzu Trooper	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Explorer/Navajo	0.002%	0.000%	0.003%	0.003%	0.004%	0.000%	0.000%	0.002%
All Other Midsize SUVs	0.000%	0.001%	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%

Table 7
Polk Registration in Florida by Model Year (Vehicle Years)

	Registration by Model Year						
Florida	1994	1995	1996	1997	1998	1999	2000
Blazer	45,220	48,110	42,170	25,742	28,782	15,844	13,172
Cherokee	56,865	48,534	45,487	12,178	17,970	11,900	4,465
Explorer	118,931	79,099	148,734	96,313	80,292	44,514	16,036
Navajo	3,022	0	0	0	0	0	-
4Runner	27,803	36,826	25,558	37,401	26,427	17,300	6,970
Pathfinder	21,169	32,553	14,520	15,605	11,027	8,620	2,987
Rodeo	30,336	45,955	18,264	19,101	17,919	13,529	3,161
Grand Cherokee	68,092	64,534	63,585	51,673	35,546	23,276	14,954
GMC Jimmy	18,351	21,908	17,965	12,759	9,440	5,297	4,707
Isuzu Trooper	10,752	7,642	5,616	1,679	2,567	1,865	470
Total	400,541	385,161	381,899	272,451	229,970	142,145	66,922
All Midsize SUVs	441,975	438,818	405,658	347,285	283,923	182,034	87,002
Explorer/Navajo	121,953	79,099	148,734	96,313	80,292	44,514	16,036
All Other Midsize SUVs	320,022	359,719	256,924	250,972	203,631	137,520	70,966
Total	441,975	438,818	405,658	347,285	283,923	182,034	87,002

Total
219,040
197,399
583,919
3,022
178,285
106,481
148,265
321,660
90,427
30,591
1,879,089
2,186,695
586,941
1,599,754
2,186,695

Attachment 6

From: CWHITE --DRBN001 Date and time 06/26/89 10:26:29
To: RSTORMAN--DRBN001 R. F. Stornant

FROM: Charles White
Subject: UN46 Design Revisions
It will be very hard to live without any 2-Door for 6 months. Is there any plan that gets us there albeit with extraordinary efforts from certain activities?
In other words, what would it take to make job #1 for the 2-door at 1991 1/2 as currently planned?

A time line with the key events is what is needed to show this I think. Cover each change separately so everyone can see the events and timing involved clearly. Cover 2-door and 4-door separately.

I support the plan as laid out, but I would like to know if there is a way to get 2-door for 91 1/2 Job #1 (or perhaps only a 60 day delay).

Be sure and have the prior material (test results, etc) available for the upcoming mtg with DSR and I -- need asap. I'm gone 7/3 - 7/5 inclusive.
*** Forwarding note from RSTORMAN--DRBN001 06/26/89 08:54 ***
To: CWHITE --DRBN001

FROM: Roger F. Stornant
Subject: UN46 Design Revisions

Attached is "Strawman" currently being reviewed with the multi-discipline group working on UN46 revisions. I believe execution of this plan would assure good performance in CU test and also allow an "on time" launch of UN46 (albeit somewhat restricted on models and tires). We have much to do before we can confirm this plan but I believe this is the direction we are currently heading.

JEE will not be available for at least two weeks so we will have meeting with you, Replogle and RRS ASAP.
Regards,
Roger F. Stornant
*** Forwarding note from RSTORMAN--DRBN001 06/23/89 11:23 ***
To: RCAMPBEL--DRBN001 RSIMPS01--DRBN001
PASHBURN--DRBN001 HWOROSZ --DRBN001
DHOUST01--DRBN001

FROM: Roger F. Stornant
Subject: UN46 Design Revisions

Based on feedback to date, from the various areas affected by the proposed changes, I am proposing the following "strawman". I believe this proposal will assure good performance in the CU Test and minimize any adverse Public Relations risk.

Job #1: .Release 4 Dr. Only, with base P225 AS Tires. Include the following design modifications:
..Higher front spring rates (FESM local upgrade req'd).
..Lower front and rear 1/2" through frame/jounce bumper revisions. (Clearance should not be an issue with tire usage restricted to P225 Only).

1991 Job#1: .Add P235 AT/P245 AS Tires to the 4dr. and release the 2 Dr. with P225 AS tires coincident with incorporation of the following revisions:

EXPT 0570

LAMPE_J-00183

..Lower Front Roll Center
..Revise Wheel house to accomodate 1/2" lower with large tires

1991 1/2 Job #1: .Add P235 AT/P265 AS Tires to the 2 Dr. coincident with
incorporation of the following design changes:
..Widen Track (axles)
..Revise FESM to accomodate wide track with large tires.

I'd like your thoughts on this proposal. We will need to revisit after APG test results are available (7/24).

Regards,
Roger F. Stornant

cc: RSIMPS01--DRBN001
DREPLOGL--DRBN001
RSIMPS01--DRBN001
DREPLOGL--DRBN001
JENGLEHA--DRBN001 J. E. Englehart
DDUKATZ --DRBN001
CWHITE --DRBN001 Charles White
DDUKATZ --DRBN001

EXPT 0571

Attachment 7

STATEMENT OF DR. DENNIS A. GUENTHER

I have been asked by counsel for Bridgestone/Firestone to carry out an investigation of the directional control of the Ford Explorer following a tire tread separation. That investigation includes accident reconstruction, review of police accident reports, vehicle measurement, and dynamic testing. I am presenting today the preliminary results of my dynamic testing; that testing is ongoing. My resume is attached to this statement as Exhibit 1.

The hypothesis addressed in my testing is that the Explorer has a control problem leading to rollover crashes following tread separation. I chose to explore the linear range of vehicle operation as a preliminary investigation because of the complexities and non-linearity of vehicles.

A description of the dynamic testing I have conducted is set forth below.

Test Site

The tests were carried out at the Transportation Research Center, Inc. (TRC) test facility near East Liberty, Ohio. The facility is used on a contract basis by automobile manufacturers, component suppliers, and state and national regulatory authorities to conduct automotive safety testing.

Study Objectives

The purpose of the testing program, which is ongoing, is to examine the margin of control in the Explorer as designed and, comparatively, in peer SUVs in the circumstance following rear tire tread separation. As noted above, I have conducted my study to this point in the linear range. In the linear range a principal parameter of control is the understeer/oversteer gradient (other parameters such as steering response time and gain, and steering frequency response are also being examined as they may relate to loss of control in the event of tire tread separation).

Test Vehicles

The vehicles evaluated are the following:

1996	Ford Explorer	4 dr	4 x 2
1996	Chevy Blazer	4 dr	4 x 2
2001	Jeep Cherokee	4 dr	4 x 2
2000	Ford Explorer	4 dr	4 x 2

Each vehicle was tested with its original equipment (OE) tires. The 1996 Explorer was tested with both OE Firestone tires and OE Goodyear tires recommended by Ford.

Vehicle Instrumentation and Measurement

The data acquired for purposes of this analysis was the following:

Vehicle Input

Steering Wheel Angle

Vehicle Speed

Vehicle Response

Lateral Acceleration

Yaw Rate

Body Roll Angle

The instrumentation and sensors used to acquire this data is identified in Exhibit 2.

Test Maneuvers

The tests conducted are universally recognized standard tests used by automobile manufacturers, including Ford, and other researchers in vehicle dynamics for establishing the values investigated. The tests are as follows:

- **Step Steer**

  The vehicle is driven on the test pad area in a straight line at a constant speed. The driver then rapidly turns the steering wheel until it hits a mechanical stop. Steering wheel stops are set to attain a desired lateral acceleration at the test speeds. This steer angle is held until steady-state response is established.

Tests were run in both directions (right turn/left turn) and at two speeds (60 mph and 40 mph). The test was run both with four good tires and with the left rear tire detreaded by cutting between the steel belts; test runs with the detreaded tire were done only at the slower 40 mph speed. Test runs were done at both light load (curb plus driver and instrumentation) and heavy load (gross vehicle weight rating).

The test is used to measure vehicle response times as related to lateral acceleration and yaw velocity response, and to measure the gain of these responses in relation to steering wheel input (output divided by input).

- **Constant Radius Circle**

The vehicle is driven around a 200 foot constant radius circle with increasing speed. The driver adjusts the steering angle (by turning the steering wheel) as necessary to keep the vehicle on the path of the circle.

Test runs were done in both directions, clockwise and counter-clockwise, with four good tires and with the left rear tire detreaded. Test runs were done at light load (curb plus driver and instrumentation) and heavy load (gross vehicle weight rating).

The test is used to measure understeer and oversteer (degrees of road wheel steer per Gs of lateral acceleration).

- **Frequency Response**

  Sinusoidal sweep steering tests are frequently used to determine the linear response of vehicles. The vehicle in these tests were driven on a long straightaway with the driver steering with slowly increasing frequency up to approximately 3 to 4 hz followed by decreasing frequency. The test was run at a nominal speed of 66 mph.

  The test measures lateral acceleration gain, yaw velocity gain, and phase angles at the frequencies tested (up to 3 to 4 hz).

Results of Directional Control Tests

The results of the constant radius circle tests are set forth in data sheets and charts attached hereto as Exhibit 3. Data reduction continues with respect to the step steer and frequency response tests.

In summary, the findings in the tests are as follows:

Constant Radius Circle – This standard method of measuring understeer/oversteer gradient establishes that the Explorer, with four good tires, has a relatively small amount of understeer compared to other SUVs – less than half the amount found in the Blazer and the Cherokee. In fact, the Cherokee has about the same understeer with a detreaded tire as the Explorer with four good tires.

The test results show that, unlike the other SUVs tested, the Explorer loses its small margin of understeer when it experiences a tread separation and becomes an oversteer vehicle.

This is true whether the Explorer is operated on Goodyear OE tires recommended by Ford or on Firestone OE tires.

The Explorer's oversteer characteristic is worse in the loaded condition. The only circumstance in which it does not become oversteer with a detreaded tire is when it is lightly loaded (curb plus driver and instrumentation) and the detreaded tire is on the inside rear position (left rear in a counter-clockwise turn); in test runs in that configuration the Explorer is almost neutral steer with respect to the understeer/oversteer gradient.

An oversteer vehicle is not safe at highway speeds in the hands of an average driver. Sometimes a driver may achieve directional control, sometimes a driver may not, particularly where the driver has to deal with the unfamiliar and unpredictable oversteer handling. The oversteer control problem is increased by virtue of the fact that the Explorer driver is used to a vehicle which is understeer and the vehicle has changed to oversteer without the driver's awareness.

CONCLUSION

The Explorer is an oversteer vehicle in most circumstances after it experiences tread separation. Oversteer can make a vehicle directionally unstable and subject to loss of control in the hands of most drivers. This is a vehicle problem, not a tire problem. The vehicle performs the same following tread separation on the Goodyear tire as it does the Firestone tire. This must be regarded as a highway safety defect within the meaning of the National Highway Traffic and Motor Vehicle Safety Act.

Linear Range Understeer Gradients

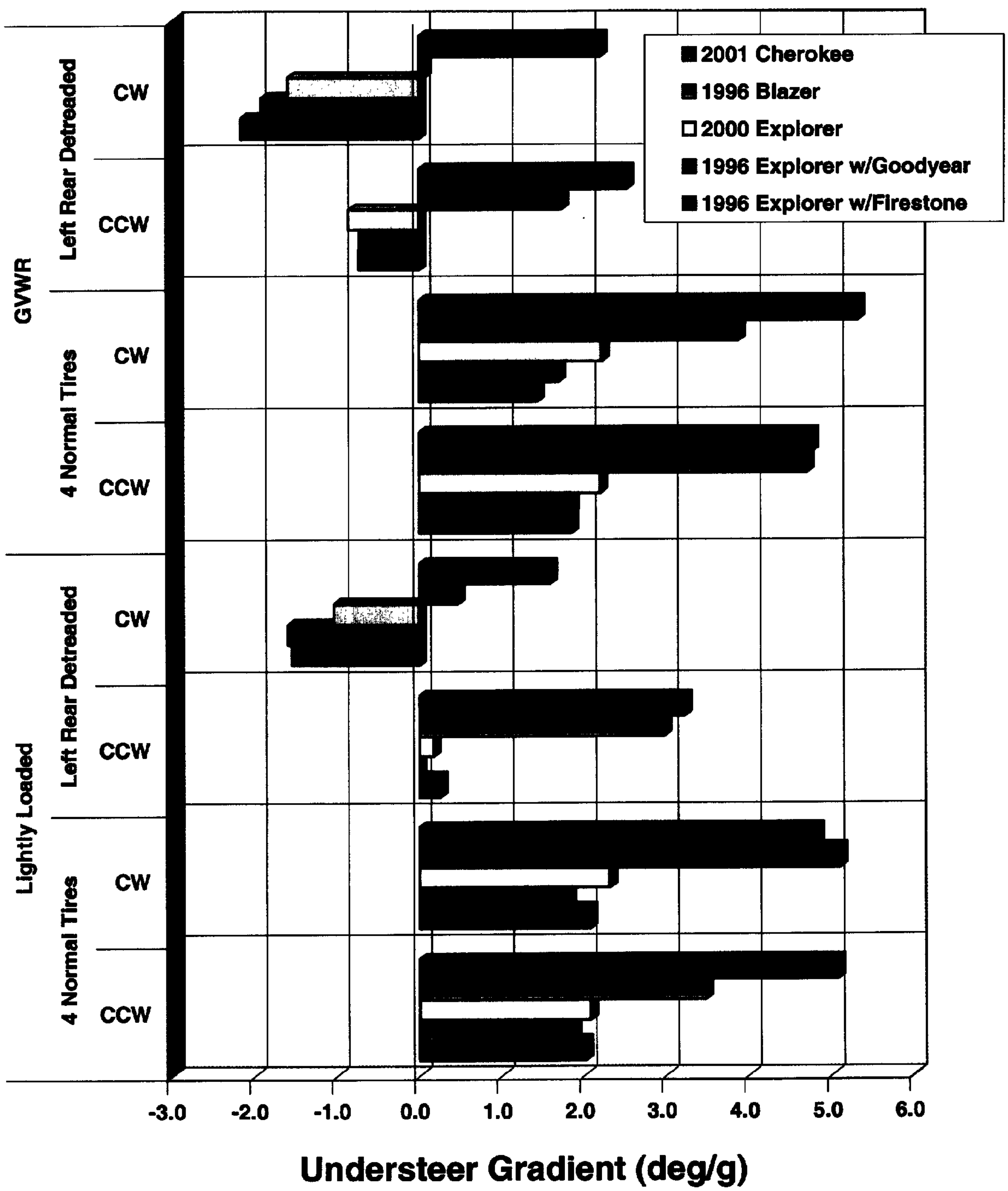

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Chart #17

Linear Range Understeer Gradients

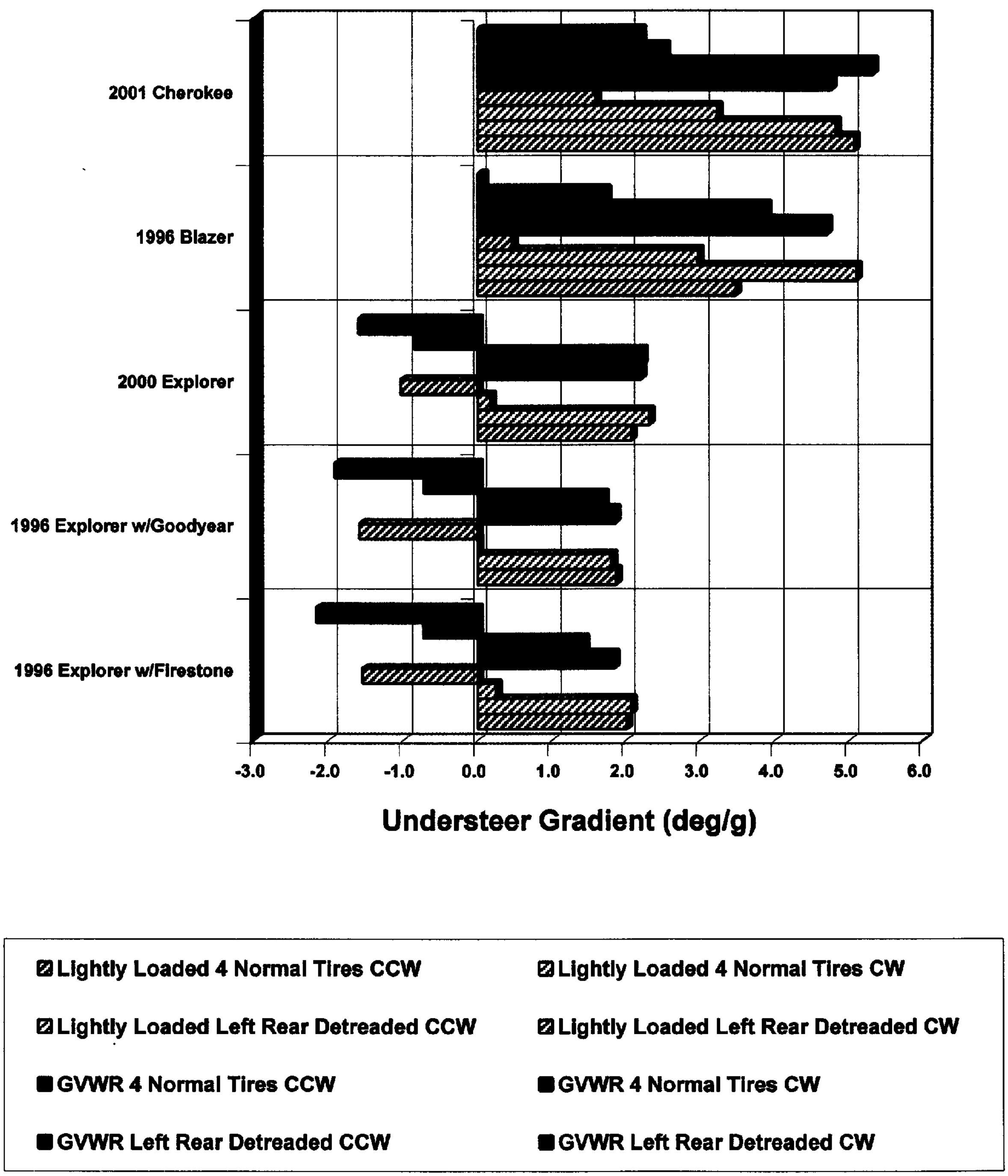
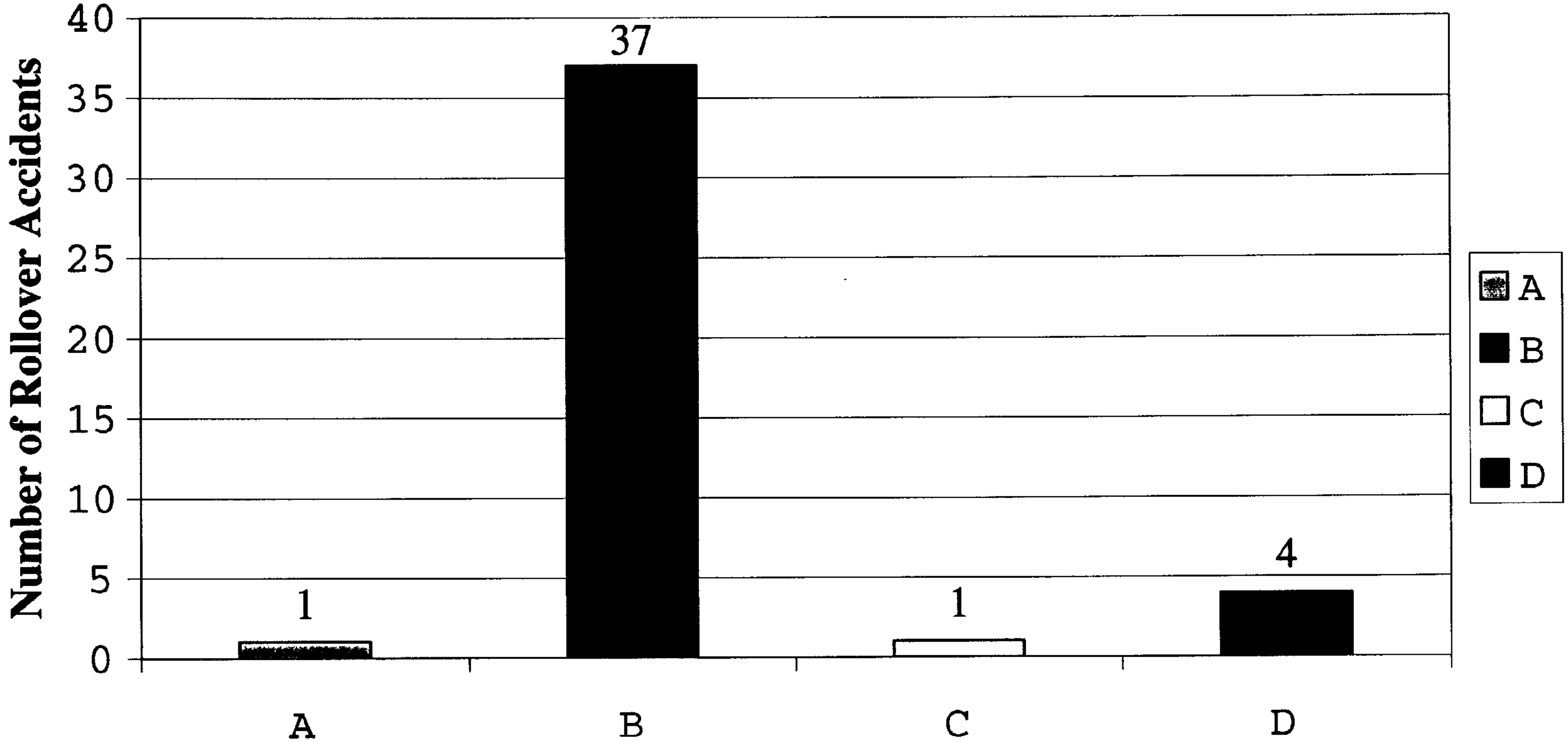


Chart #18

Documented Ford Explorer Rollover Accidents on Competitive Tires in Venezuela From May '00-June '01



Tire Brand (Firestone not represented)

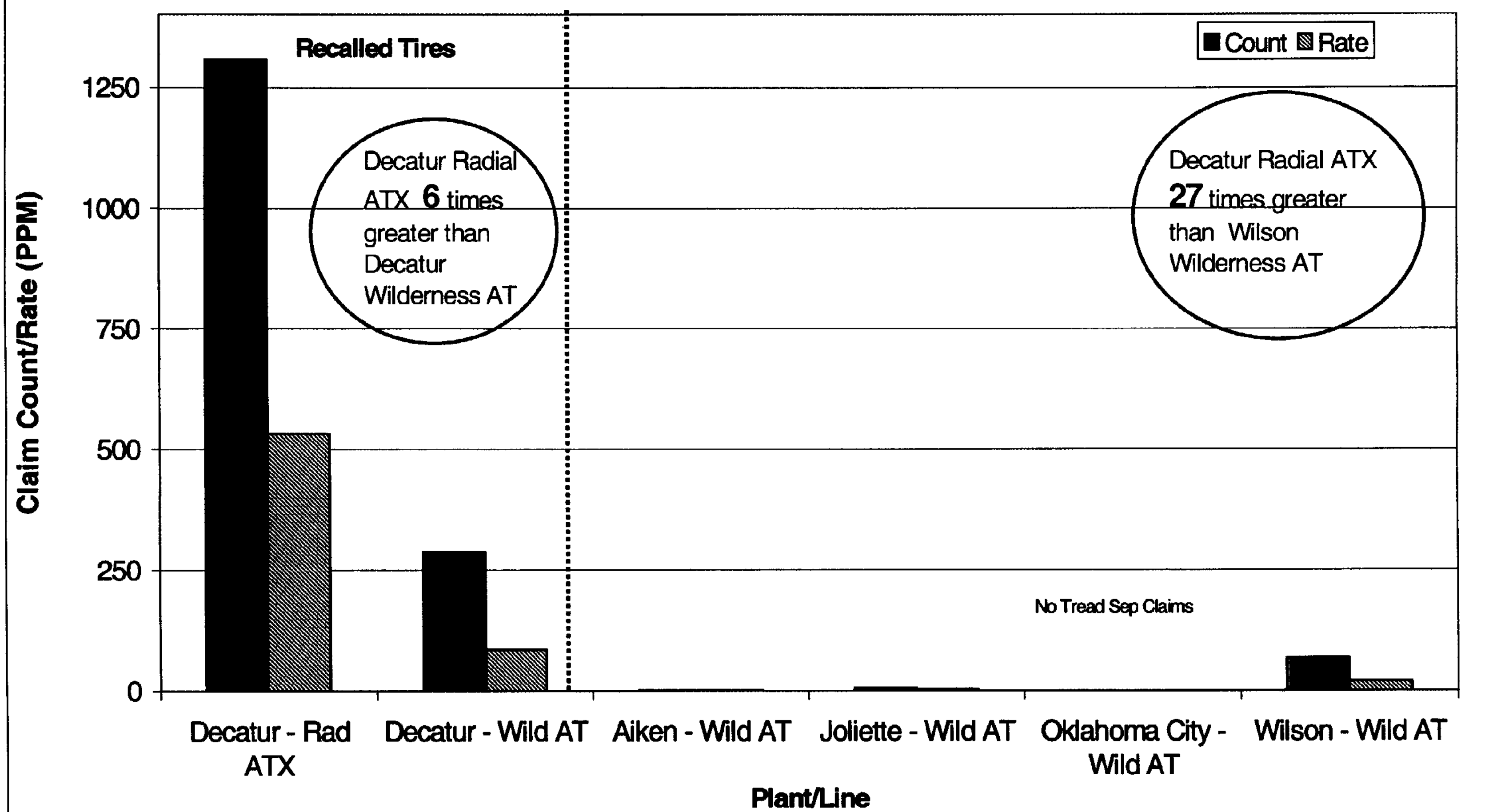
Source: Venezuelan Judicial Inspections
Manufacturers represented include the following: BF Goodrich, Continental, Dunlop and Goodyear

Attachment 8

BFS Claims By Plant Tread Separations

Recalled Decatur Radial ATX Compared to Wilderness At P235/75R15

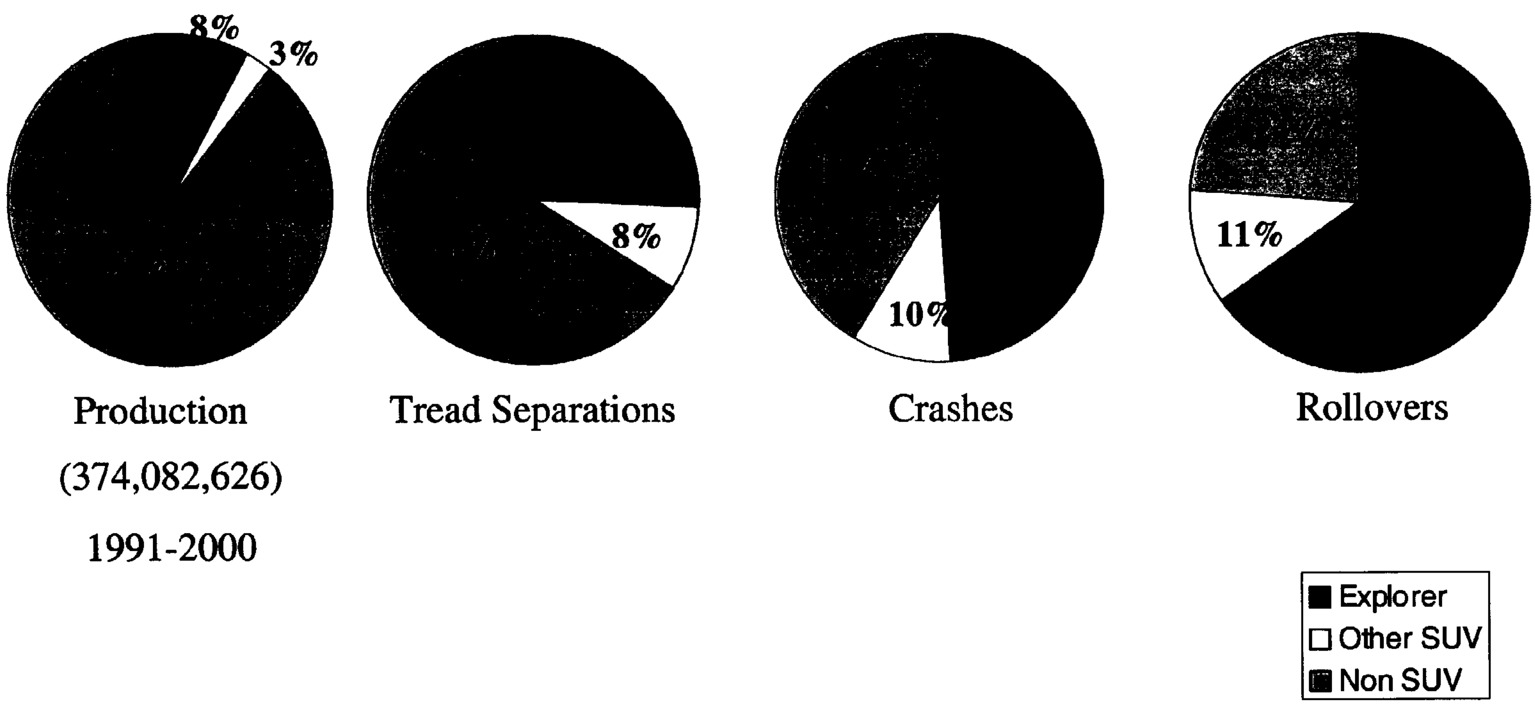
Tires Produced 1991-2000



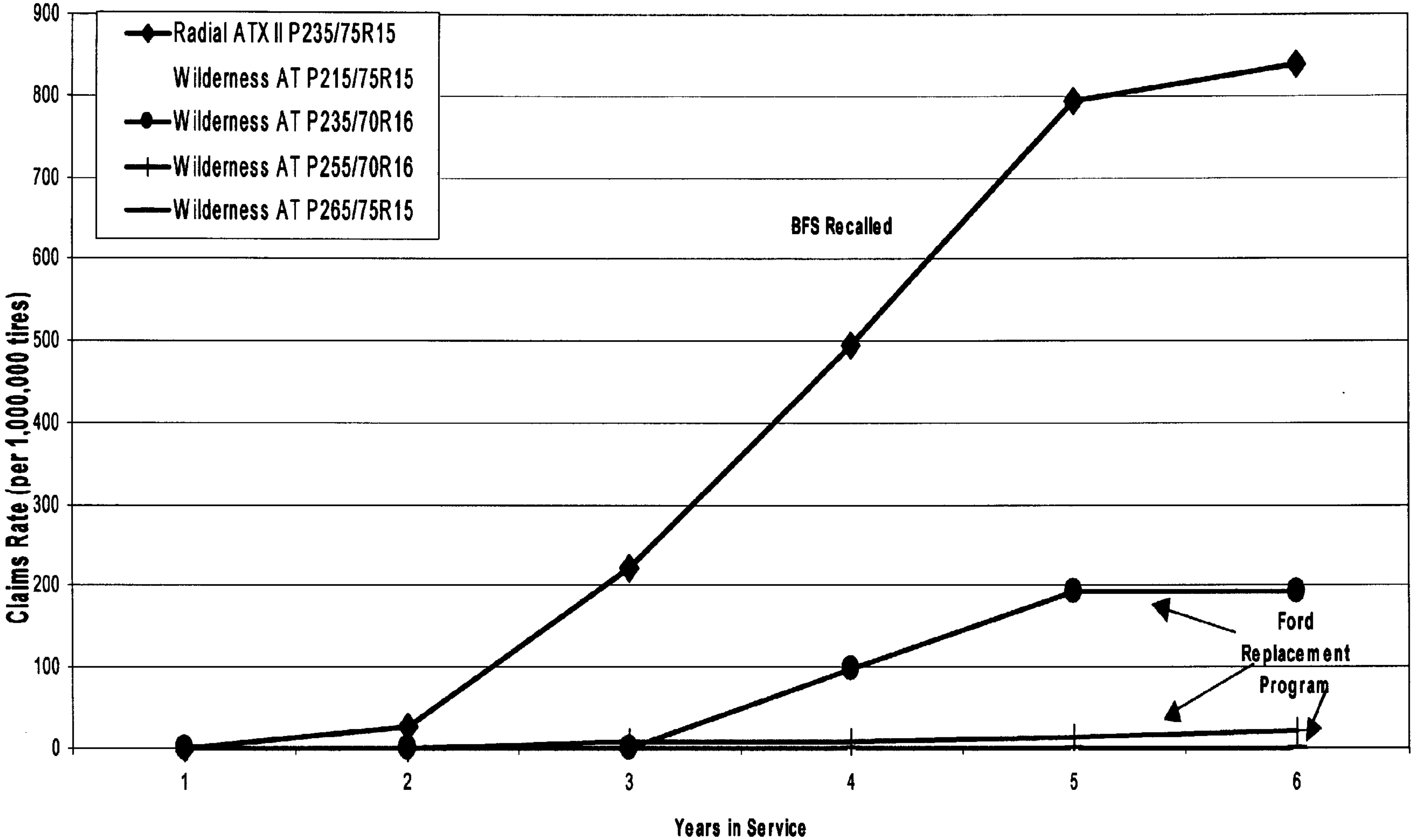
Decatur - Rad ATX		*Decatur - Wild AT*		*Aiken - Wild AT*		*Joliette - Wild AT*		*Oklahoma City - Wild AT*		*Wilson - Wild AT*	
Total Prod.	2,452,653	Total Prod.	3,378,471	Total Prod.	2,189,154	Total Prod.	1,596,589	Total Prod.	74,069	Total Prod.	3,437,840

Explorer: A Growing Problem

Explorer Incident Severity Disproportionate to Production



Recall Sizes vs. Ford Replacement Program Sizes
Tread Separation Claims
Production Year 1995



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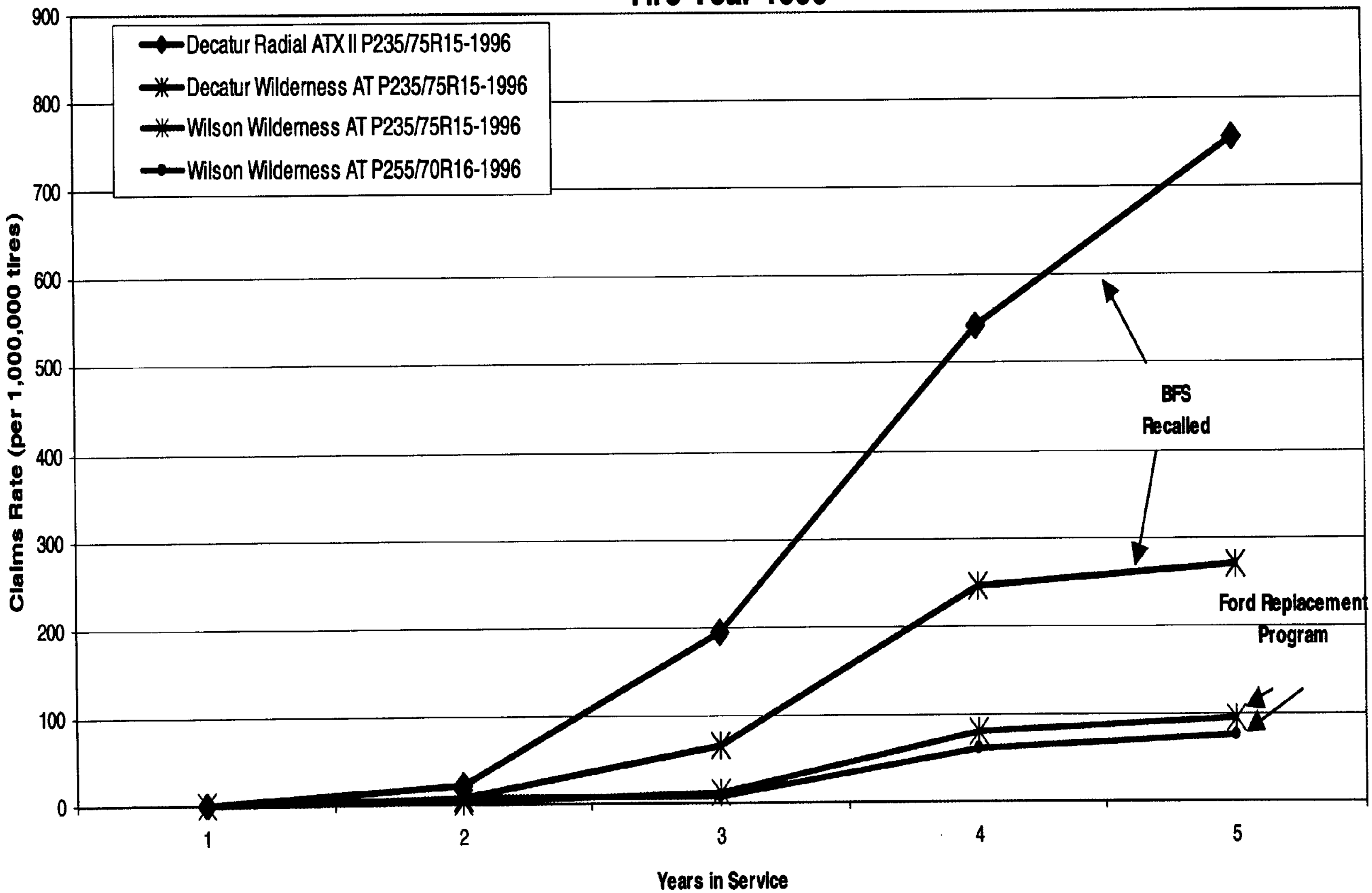
Decatur vs. Wilson
Tread Separation Claims
Tire Year 1996



SCRAP TREAD SURVEY – TUSCON, AZ. 05/23/01

FINDINGS:

	Mfg	SCRAP COUNT	SCRAP SHARE	US MARKET SHARE 1.)
2.)	UNKNOWN	70	31%	
	MICHELIN	37	16%	24%
	BFS	35	15%	21%
	GOODYEAR	29	13%	29%
	CONTINENTAL	26	11%	7%
	COOPER	13	6%	6%
	KUMHO	5	2%	
	YOKOHAMA	3	1%	
	PIRELLI	2	1%	
	HOOSIER	1	0%	
	OHTSU	1	0%	
	FEDERAL	1	0%	
	CORDOVAN	1	0%	
	TOYO	1	0%	
	BIG-O	1	0%	
	WOOSUNG	1	0%	
	ACADEMY	1	0%	
	HANKOOK	1	0%	
	TOTAL	229	100%	

Waiting for correct info from Laubie

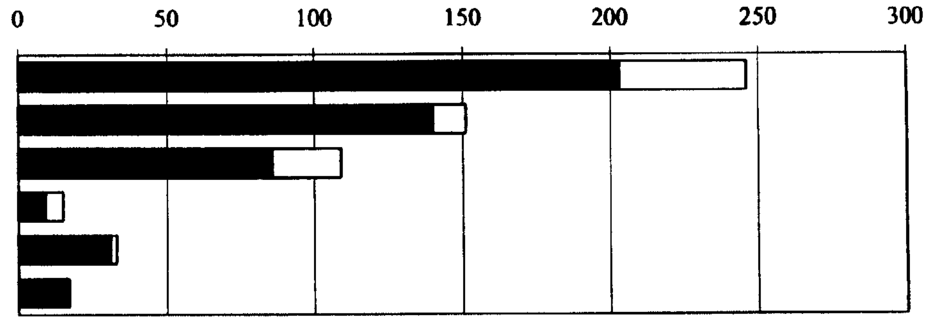
NOTES:

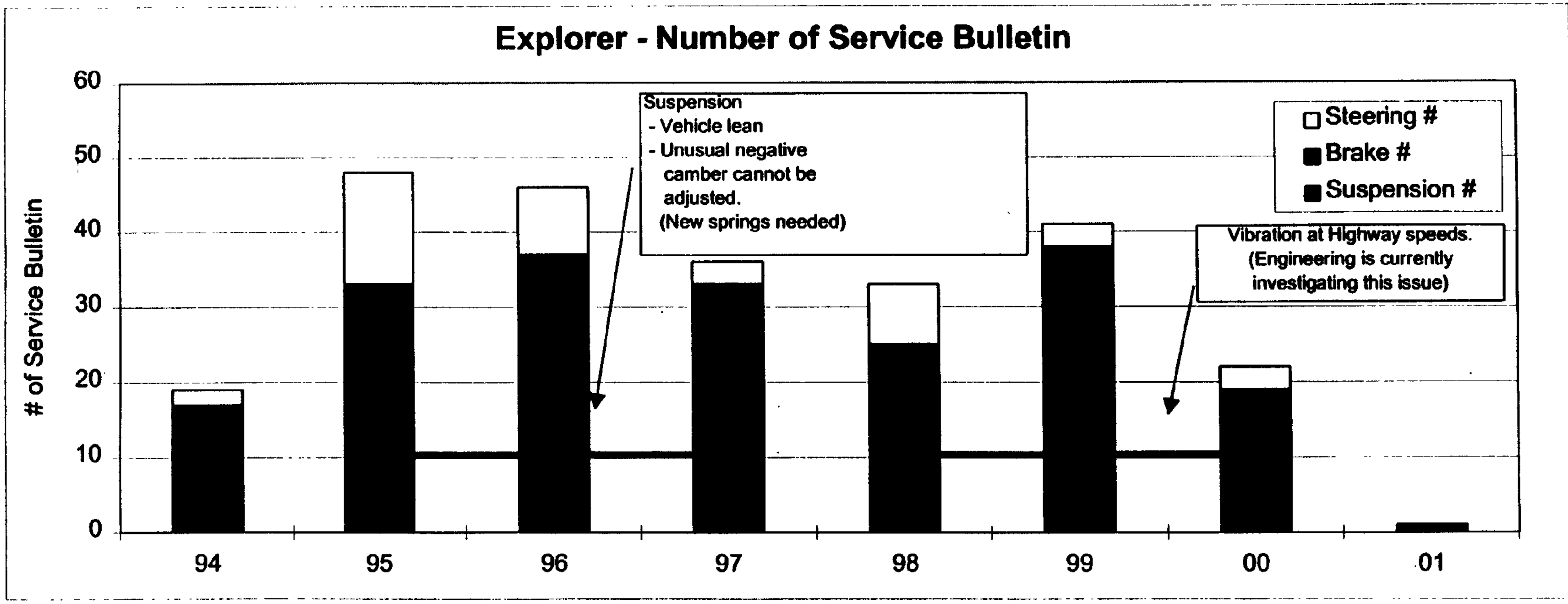
1.) US MARKET SHARE FROM "TIRE BUSINESS"

2.) 70 UNKNOWN – NOT BFS
- MANUFACTURER/BRAND/PATTERN NOT IDENTIFIED
- WOULD INCREASE COMPETITOR SCRAP SHARE

Number of Service Bulletins by Vehicle - Model Year 1994-2001

MODEL		Suspensio	Brake	Steering
Ford	**Explorer**	121	82	43
	Ranger	61	79	11
	F150	27	59	23
GM	Blazer	3	6	6
	Suburban	0	31	2
Toyota	4Runner	3	14	0





BRIDGESTONE/FIRESTONE, INC.
50 Century Boulevard
Nashville, TN 37214
Phone: 615-872-1486
Fax: 615-872-1490

MEMORANDUM
June 19, 2001

As part of its presentation to both the Commerce, Trade and Consumer Protection and Oversight and Investigations Subcommittees of the House Committee on Energy and Commerce, Bridgestone/Firestone, Inc. would like to submit the enclosed evidence relating to accidents involving the Ford Explorer in Venezuela. This evidence supports our position that the Ford Explorer is not a stable vehicle, regardless of which tires are mounted on the vehicle.

Here is a brief explanation of each category of evidence we are submitting:

1. A VHS videocassette tape (approximately 8 minute running time). The cassette shows how Ford responded to certain Explorer Rollover Accidents: in approximately April 2000, Ford of Venezuela sent letters to some Ford Explorer owners in Venezuela. The letters invited them to come to Ford dealerships for a suspension upgrade—at a cost to each owner of approximately $400-500 for the full upgrade. The tape shows before and after images of the underside of a Ford Explorer sent to a Ford dealership for the upgrade. The upgrade package included the addition of new front and rear shock absorbers, a heavy reinforcing steel bar and the substitution of Goodyear Wrangler tires. The audio portion is in Spanish; a translation is forthcoming.

2. 43 Venezuelan Judicial Inspections. The judicial inspections are records of evidence notarized and validated by a judge. Under Venezuelan legal rules, physical evidence, such as damaged vehicles can be admitted in court only if a Venezuelan judge, accompanied by an expert such as a mechanic as well as a photographer, has personally viewed the damaged vehicle to confirm its condition. At the request of Bridgestone/Firestone Venezolana, Venezuelan judges visited the wreckage of 43 Ford Explorers that have been involved in rollover accidents since May 1, 2000, in order to verify the condition of the vehicle and the brand and condition of the tires fitted on those vehicles. The inspections show that Ford Explorers are continuing to rollover in Venezuela (at an alarming rate), regardless of the changeover from Firestone to Goodyear tires. In order to facilitate review of this voluminous evidence, enclosed is a chart and a spreadsheet listing the key aspects of each judicial inspection.

3. A letter dated September 20, 2000, from Bridgestone/Firestone, Inc. senior counsel John Harrington to Ford attorney Richard Goetz (then present at Ford of Venezuela) requesting rollover crash and claims statistics for the Ford Explorer as well as information on the suspension changes to the vehicle. Bridgestone/Firestone never received a response to this request.

We urge you to review this material carefully. We believe that this material constitutes incontrovertible evidence of Ford Explorer's instability, regardless of the tires fitted on it, and that Venezuelans are continuing to suffer the consequences for that instability. Thank you for your time.

FORD EXPLORER ROLLOVER ACCIDENTS - VENEZUELA - JUDICIAL INSPECTIONS

Nbr.	Judicial Inspect#	Vehicle	License Plate	Date of Inspect	Type of Accident	Tires Mounted	Notes
1	3307	Ford Explorer XLT 4x4	GAT-36F	6/12/2000	Rollover	Continental Contitrac M&S LT235/75 R15 (All)	Passenger-front deflated but tread intact on all.
2	54/2000	Ford Explorer XLT 4x2	OAD-41H	8/7/2000	Rollover	Goodyear Wrangler RTS M+S P255/70 R16 (All)	Driver-front tire deflated, but tread intact on all.
3	1483	Ford Explorer	DAZ-86F	8/9/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (All)	All four tires inflated and tread intact, but GY spare flat (tread intact)
4	3370	Ford Explorer 4x2	GAU-77E	8/17/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (All)	Driver side front deflated, but tread intact on all.
5	2347-2000 2465-01	Ford Explorer XLT 4x4 1998	GAT-37G	8/24/2000 3/26/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (All)	Front tires flat, all tires with tread intact.
6	1491	Ford Explorer XLT 2000	VAI-77P	8/31/2000	Rollover	Goodyear Wrangler RTS P255/70 R16 (All)	Driver-rear punctured and deflated, but tread intact on all.
7	3377	Ford Explorer XLT 4x2 2000	GBH-88A	9/5/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (All)	All four tires inflated and tread intact.
8	1493	Ford Explorer XLT 4x2 1997	AAR-32A	9/7/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (All)	All four tires inflated and tread intact.
9	3382 3384	Ford Explorer 4x2 1997	GAO-41C	9/25/2000 9/27/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (All)	All four tires inflated and tread intact.
10	3392 3393	Ford Explorer XLT 4x4 1998	GAS-11H	9/28/2000 9/28/2000	Rollover	Goodyear Wrangler RTS P255/70 R16 (All)	Three tires are deflated, all treads are intact.
11	1770 1771	Ford Explorer XLT 4x2 1996	KAD-50P	10/16/2000 10/16/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Passenger front tire deflated, but all tread intact.
12	3439	Ford Explorer 4x2 1998	EAD-33E	11/10/2000	Rollover	Goodyear Wrangler RTS LT 235/75 R15 (all)	All four tires inflated and treads intact.
13	2402-2000	Ford Explorer XLT	GBC-96X	11/27/2000	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All four tires inflated and tread intact.

Nbr.	Judicial Inspect#	Vehicle	License Plate	Date of Inspect	Type of Accident	Tires Mounted	Notes
14	102-2000	Ford Explorer XLT 4x4 1997	IAB-33I	11/6/2000	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All tires flat, treads appear intact.
15	323	Ford Explorer C72 2001	None	12/4/2000	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Passenger front tire flat. Treads appear intact.
16	3493	Ford Explorer 1998	KAK-02M	1/10/2001	Rollover	Goodyear Wrangler RTS LT235/75 R 15 (all)	Front tires deflated; rear tires inflated. All treads appear intact.
17	7128	Ford Explorer XLT 4x2 1998	KAK-94M	1/22/2001	Rollover	BF Goodrich P295/50 R15 (all)	All four tires inflated and tread intact
18	01-844	Ford Explorer XLT 4x2 2000	ABI-25W	2/5/2001	Rollover	Goodyear Wrangler ATS LT235/75 R15 (all)	All four tires inflated and tread intact
19	01-845	Ford Explorer XLT 4x4 2000	JAH-45F	2/5/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All four tires inflated and tread intact
20	53/2000	Ford Explorer XLT 4x4 1999	DAZ-39B	2/7/2001	Rollover	Dunlop Grandtrek LT265/75 R16 (all)	All four tires inflated and tread intact
21	3807	Ford Explorer XLT 4x4	GAO-42D	2/12/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	Two front tires deflated by impact but tread intact on all
22	18-2001	Ford Explorer 1997	JAC-72G	2/20/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Three tires remained intact. Tread is separated on the fourth tire.
23	34/2001	Ford Explorer XLT	ABD-81C	3/8/2001	Rollover and impact	Goodyear Wrangler RTS	Passenger front tire deflated, but tread intact on all
24	35/2001	Ford Explorer XLT 1998	BAC-08T	3/8/2001	Rollover	Dunlop Grandtrek (all)	Passenger front tire missing and rear deflated but tread intact. Driver tires treads intact.
25	20/2001	Ford Explorer 2000	KAP-72S	3/9/2001	Rollover	Goodyear Wrangler RTS (all)	Front tires inflated and treads intact. Driver rear flat, tread intact. Passenger rear unmounted [in the back].

26	1560	Ford Explorer XLT 4x2 1998	GAT-76H	3/22/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	All four tires inflated (one depressed into sand) and treads intact
27	2463-01	Ford Explorer XLT 4x4	DAM-43U	3/24/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All four tires inflated and treads intact
28	2464-01	Ford Explorer XLT 4x4 1998	DAK-83O	3/26/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	Driver rear tire badly damaged, driver front deflated but tread intact. Passenger tires inflated and treads intact.
29	2466-01	Ford Explorer XLT 4x4 1998	DAF-21N	3/26/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All four tires inflated and treads intact
30	2447-01	Ford Explorer	KAK-94L	3/5/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Driver front tire flat and unmounted, passenger front flat, both treads intact. Both rear tires inflated, treads intact.
31	568-01	Ford Explorer 4x2 1997	GAN-12Z	4/23/2001	Rollover	Goodyear Wrangler RTS LT235/70 R15 (all)	Two tires deflated, but tread appears intact on all

Nbr.	Judicial Inspect#	Vehicle	License Plate	Date of Inspect	Type of Accident	Tires Mounted	Notes
32	569-01	Ford Explorer 4x2 1999	SAJ-52B	4/23/2001	Rollover	Goodyear Wrangler RTS LT235/70 R15 (all)	Driver front tire only is deflated; treads intact on all
33	3762	Ford Explorer 4x2	DBA-58Z	4/24/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	All four tires inflated and treads intact
34	3765	Ford Explorer 4x2 2000	GBC-29Y	4/25/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Treads appear intact.
35	2421	Ford Explorer XLT 1998	DAO-61H	5/27/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	All four tires inflated and treads appear intact
36	10108	Ford Explorer XLT	ABI-28V	5/28/2001	Rollover	Goodyear Wrangler RTS (all)	Driver front tire deflated, but treads appear intact on all

37	2001-5601	Ford Explorer XLT 4x4	LAF-88I	5/30/2001	Rollover	Goodyear Wrangler RTS 255/70 R16 (all)	Passenger front tire & rim demolished; driver rear tire badly damaged. Other two tires inflated, treads intact.
38	219	Ford Explorer 1998	TAA-84O	6/4/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Treads appear intact. Driver front tire is flat.
39	67	Ford Explorer XLT 4x2 1997	PAE-49B	6/8/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15 (all)	Both front tires deflated, all treads intact.
40	2001 1003	Ford Explorer 2001	DAZ-93J	6/11/2001	Rollover	Dunlop A/T 31x10.50 R15 LT (all)	Driver front tire destroyed. Passenger front & rear deflated; treads appear intact Driver rear inflated and tread intact
41	2001-1004	Ford Explorer 1999	FAO-00B	6/11/2001	Rollover	Goodyear Wrangler RTS LT235/75 R15	Two front tires missing. Rear tires inflated, treads appear intact.
42	1927	Ford Explorer XLT 4x4 1999	LAB-51R	6/13/2001	Rollover	Dunlop RV LT 245 75 R16 (all)	Treads appear intact. Driver front tire is flat.
43	1928	Ford Explorer 4x4	None	6/13/2001	Rollover	Goodyear Wrangler RTS P255/70 R16 (all)	Passenger rear is flat. Treads appear intact.

September 20, 2000

BRIDGESTONE/FIRESTONE, INC.
LAW DEPARTMENT

John Harrington
Senior Counsel – Corporate & International

50 Century Boulevard
Nashville, TN 37214
Phone: 615-872-1486
Fax: 615-872-1490

Via Federal Express and Facsimile (313) 332-4986 and (58) 41 407736

Richard Goetz, Esq.
Assistant General Counsel/International
Ford Motor Company
Dearborn, Michigan
48121-1899

Dear Richard:

I am glad that we were able to speak yesterday afternoon with regard to the information requests relating to Venezuela set out in Mr. Mazzorin's letter of September 14, 2000 to Mr. Kaizaki. As I briefly outlined to you during our telephone conversation, Bridgestone/Firestone Venezolana, C.A. ("BFVZ") is ready, willing and able to make a full and rapid disclosure of all claims and adjustment data for tires it has produced and which were utilized on your Ford Explorer sport utility vehicle in Venezuela, in exchange for full claims and adjustment data regarding Explorers produced in Venezuela and at a minimum the following additional information from 1991 to date regarding such Explorers:

- All documents relating to changes made to the Ford Explorer suspension (including but not limited to shock absorbers, anti-sway bars and reinforcing plates); and

- Any Ford Explorer claim data showing any problems (accidents, rollovers, tread separations) with other manufacturers' tires.

I wish to emphasize the principle of reciprocity in this proposed exchange. As you know, Bridgestone/Firestone, Inc. ("BFS") has transmitted large amounts of adjustment data to Ford in the United States. Furthermore, BFVZ has transmitted additional information to Ford of Venezuela. To the best of my knowledge, neither Ford Motor Company nor Ford of Venezuela have ever made reciprocal disclosures of data or documents to BFS or to BFVZ. Given this fact, and the evidence we see that the Ford Explorer vehicle is at least partly responsible for many of the rollover accidents which continue to occur in Venezuela (including accidents involving tires produced by other manufacturers), I believe that we are entitled to a full, reciprocal disclosure of Ford Explorer adjustment and claims data as well as the other information listed above.

A

With regard to plant visits. I believe that such visits should be conducted by a neutral third party and that under the policy of reciprocity such party should make an inspection of equal duration at each of BFVZ's and Ford of Venezuela's plants.

I reiterate that BFVZ is ready. willing and able to make a full and rapid disclosure of all claims and adjustment data for tires it has produced and which were utilized on the Ford Explorer. in exchange for full claim and adjustment data on Explorers produced in Venezuela as well as the additional information listed above. In the interest of consumer safety, I believe that such exchange should occur as soon as possible.

If Ford is willing to discuss this offer. please contact me as soon as possible at the above number. Thank you.

Sincerely yours,

John Harrington

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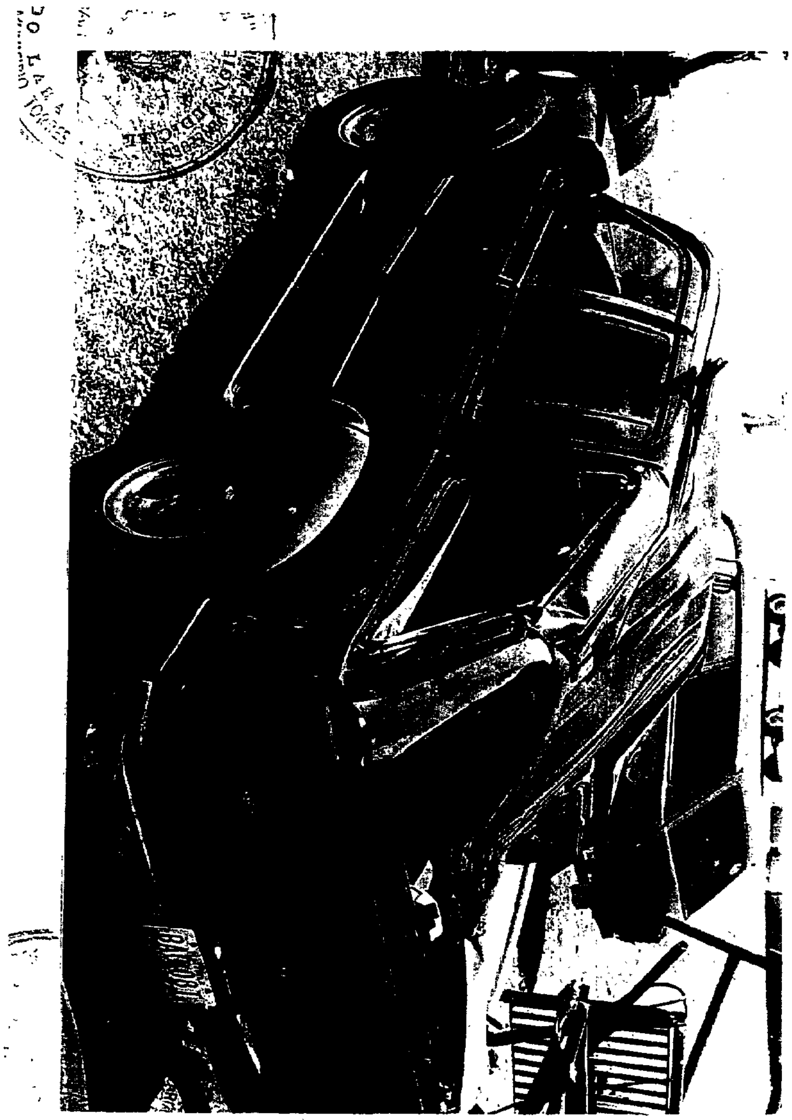

Seis (6)

Folio Nueve (9)